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Post-Acute Care Payment Reform Demonstration: Final Report

Volume 4 of 4

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This document represents Volume 4 of 4 of the final report for the Post-Acute Care Payment Reform Demonstration (PAC-PRD). This project was conducted by RTI International under contract with the Centers for Medicare & Medicaid Services. The report has 12 sections, which are divided into four volumes.

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SECTION 7
OUTCOMES: HOSPITAL READMISSIONS

Outcomes are an important consideration in examining post-acute care (PAC) services, particularly because the same type of services may be provided in more than one type of site. Outcomes help us understand the efficacy of the service provided. However, outcomes are also highly associated with patient characteristics, making it critical to understand these relationships and appropriately risk-adjust the outcomes analyses. Until now, comparisons of outcomes and quality across the PAC settings have been difficult because of the lack of comparative measures and the vast differences in processes used at each setting to achieve the desired outcomes (Johnson et al., 2002). This issue, along with the geographic variations in the use of PAC and the tendency of Medicare beneficiaries to receive PAC in more than one setting, complicates the ability to understand and evaluate outcomes and quality for PAC. When measuring outcomes and quality in PAC provider settings, previous studies have highlighted the importance of medical outcomes such as rehospitalization rates and mortality, as well as changes in physical, cognitive, psychological, and social functional status as outcomes (Arling et al., 2000; Duncan and Velozo, 2007; Johnson et al., 2002; Kilgore et al., 1993; Oken et al., 1994).

This and the following chapters examine whether patient outcomes are associated with the type of PAC setting used after controlling for patient acuity. Two types of outcomes are considered: all-cause acute readmission within 30 days of hospital discharge and functional change from admission to discharge within the PAC setting. Hospital readmission is a commonly used measure of adverse outcomes for patients who were previously treated in the acute care hospital. This chapter examines how patient risk for readmission (from any cause) varies by the type of PAC services received after holding patient characteristics equal. The following chapter examines functional change for patients treated in a PAC setting (Section 8).

7.1 Readmissions Introduction

Hospital readmissions are of concern because they increase costs and may indicate poor quality, such as premature discharge or poorly supported patient transitions, as well as potential quality concerns related to care patients are receiving in PAC settings. Readmissions put patients at greater risk for iatrogenic infections and other complications and are generally undesirable from a patient perspective. Identifying risk factors for readmission that are modifiable through high-quality care is important and can include identifying settings that may be more successful at preventing patient readmissions after adjusting for patient case-mix characteristics. Readmissions occurring within the 30 days after an acute discharge have been targeted by the Centers for Medicare & Medicaid Services (CMS) in a variety of efforts across the health care continuum to reduce costs and improve patient care and outcomes including the national Quality Improvement Organization Ninth Statement of Work and the Home Health Quality Initiative. Multiple ways of examining readmissions have been used in prior studies, including attempts at identifying potentially preventable or avoidable readmissions or excluding readmissions for unplanned reasons. These refinements to an outcome measure may be desirable, as they should better identify readmissions that are related to quality of care; however, defining each of these types of readmissions is difficult, fraught with potential for misclassification, and influenced by limitations of diagnosis coding in the PAC facilities and readmitting hospitals. Readmissions can be the result of a complicated series of decisions and events and difficult to readily identify in a systematic way as being avoidable (for example, a readmission for a hip fracture resulting from a fall in a skilled nursing facility [SNF] may have been a preventable event if the patient's fall was a result of sedating effects of a medication administered in the SNF). As yet, an accepted definition of an avoidable hospitalization for the PAC population has not been developed and validated. This study therefore targets all-cause readmissions occurring within 30 days of the prior acute discharge.

7.2 Literature Review

As stated above, readmission rates among Medicare beneficiaries contribute substantially to overall health care expenditure in the United States. For example, Jencks and colleagues (2009) found that rehospitalizations among Medicare beneficiaries are both prevalent and costly. Almost one-fifth (19.6 percent) of the 11,855,702 Medicare beneficiaries in their analysis were rehospitalized within 30 days of discharge, while 34.0 percent were readmitted within 90 days. About two-thirds of patients who were discharged with medical conditions and half of those discharged after a surgical procedure were rehospitalized within a year of discharge. The authors estimate that in 2004, unplanned rehospitalizations represented $17.4 billion in Medicare expenditures. A more recent study of readmissions occurring during episodes of PAC using 2006 Medicare claims showed that over 60 percent of readmissions occurred within 30 days of the prior acute discharge (Gage et al., 2009b). Identifying common predictors of readmission may facilitate the design of appropriate legislative responses and improved patient care strategies. For example, Silverstein et al. (2008) contend that elders with a high risk of 30-day readmission can be identified early in their hospital course. In their study of 22,292 U.S. adult patients 65 years of age or over, the authors found that factors independently associated with an increased risk of 30-day readmission include male sex, African-American race, age of 75 years or older, medical (as contrasted to surgical) service admission, Medicare-only insurance status, discharge to an SNF, and the presence of either specific Elixhauser or High Risk Diagnoses for the Elderly Scale (HRDES) comorbidities, including cardiovascular disease, chronic lung disease, renal failure, cancer, and diabetes mellitus. Identifying patients with high risk for readmission at the start of their PAC services may help providers better implement targeted protocols and screening to recognize or prevent clinical destabilization earlier and to apply appropriate interventions to forestall the need for readmission.

Studies of risk factors for readmission among Medicare beneficiaries have focused on a range of patient characteristics, disease characteristics, and health care system dynamics. However, to date there is widespread disagreement over what constitutes the ideal methodological approach when it comes to the construction of accurate predictive models for the purpose of identifying patients with an increased risk of readmission. Studies use a variety of outcome definitions that vary by disease criteria counting all causes or imposing restrictions on outcomes based on the reason for readmission versus disease-specific or avoidable readmissions. Follow-up periods for readmissions also vary, including 30 days, 60 days, 6 months, 100 days, 1 year, or even longer. For example, in their review of 117 publications that employed original data and conducted quantitative analyses to predict readmission for heart failure (HF), Ross et al. (2008) found that none compared readmission rates across provider settings, only five presented predictive models, and 112 examined patient characteristics associated with readmission. The authors found that the studies varied greatly in methods of case identification, used a range of different data sources, established few patient characteristics consistently associated with readmission, and frequently analyzed differing outcomes, often focusing on either readmission alone or on a combined outcome of readmission or death measured across varying periods of time. Variables that were consistently tested across models, such as age, sex, diabetes, and hypertension diagnoses, did not consistently predict readmission. They did, however, find that studies from the United States tended most often to use 30-day all-cause readmission as their outcome definition and that the majority of studies did not combine readmission and death in their outcome variable, though a quarter did conduct separate analyses of mortality. Patients who had died were excluded from analysis in about 10 percent of the studies sampled. A similar review of 35 studies of readmission among patients who were discharged after hospitalization for acute myocardial infarction (AMI) similarly found a wide variety of methods for statistical analysis, case definition, follow-up periods, etc., and similarly found few patient characteristics consistently associated with readmission (Desai et al., 2009). The majority of the AMI studies examined mortality as a separate outcome, some in separate analyses and some included as part of a polytomous outcome. From a policy perspective, such discrepancies make it difficult to stratify patient risk for readmission after hospitalization and to compare and profile facilities on the basis of readmission rates (Ross et al., 2008; Desai et al., 2009).

Several studies have focused on readmissions among patients diagnosed with HF, which ranks among the leading causes of hospitalization and eventual readmission of Medicare patients (Bueno et al., 2010; Curtis et al., 2008). Curtis et al. (2008) examined 2.5 million Medicare beneficiaries 65 years of age or over who were hospitalized between 2001 and 2005 with a primary diagnosis of HF. They found that nearly one in four patients involved in the study were readmitted within 30 days of their index hospitalization, while two-thirds were readmitted within 1 year. Philbin and DiSalvo (1999) contended that patient characteristics, hospital features, processes of care, resource use, and clinical outcomes measures can be used to estimate the risk of readmission for patients admitted for chronic heart failure (CHF). In a sample of 42,731 patients (with a mean age of 74 years), 9,112 were readmitted for CHF. The authors found that African-American race, use of Medicare or Medicaid insurance, ischemic heart disease, idiopathic cardiomyopathy, prior cardiac surgery, peripheral vascular disease, renal disease, diabetes mellitus, and anemia were associated with an elevated risk of readmission. Conversely, patients undergoing echocardiography, exercise stress testing, cardiac catheterization, coronary revascularization, or any cardiac surgical procedure were less likely to be readmitted. Felker et al. (2004) argue that risk stratification of patients with decompensated HF may be accomplished using easily assessed clinical variables. The authors found that predictors included the number of HF hospitalizations in the preceding 12 months, elevated blood urea nitrogen, lower systolic blood pressure, decreased hemoglobin, and a history of percutaneous coronary intervention. Keenan et al. (2008) developed a Medicare claims-based model to calculate risk-standardized 30-day all-cause readmission rates for HF patients 65 years of age or over for the purpose of profiling hospital performance. Informed by prior research, a physician team selected risk factors for the final model, which included 37 variables (e.g., age; sex; history of coronary bypass graft surgery; and comorbidity indicators defined using Hierarchical Condition Categories [HCCs], including chronic obstructive pulmonary disease [COPD], diabetes, anemia, pneumonia, and other cardiovascular diseases). Variables were selected on the basis of statistical association with and clinical relevance to readmission. The authors validated the model with claims and medical record data and found discrimination ranging from 15 percent observed 30-day readmission rate in the lowest predictive decile to 37 percent in the uppermost decile, and a c-statistic of 0.60. Authors obtained similar results for models developed using data from medical records (e.g., age; sex; and selected diagnoses, including COPD, dementia, diabetes, and HF), in addition to a set of physiologic factors (e.g., blood pressure, heart rate, sodium, creatinine, glucose, and hematocrit). In their study of 2,176 patients, 65 years of age or over and admitted with HF (mean age 78.9 years; 59 percent female; 89 percent White), Krumholz et al. (2000) analyzed the impact of demographics; patient medical history; clinical characteristics upon admission; physiologic factors, including left ventricular ejection fraction, sodium, potassium, and other lab measures; major complications, including cardiac arrest, stroke, and myocardial infarction; major procedures; length of stay (LOS); and discharge mobility measures in their model. Authors used Cox models to predict readmission, but also did a validation study using combined all-cause readmission and mortality to check their results. The authors found that only a few factors were significantly predictive of all-cause readmission: prior admission within 1 year, prior HF, diabetes, and creatinine levels greater than 2.5 mg/dl at discharge.

Smith et al. (2005) compared the course of care and outcomes between stroke patients 65 years of age or over in health maintenance organizations (HMOs) and fee-for-service (FFS) plans. Patients who died were censored in their Cox model predicting readmission. The authors found that HMO patients were at greater risk of rehospitalization within 30 days than FFS patients, despite having more characteristics generally associated with lower risk, such as being younger, male, non-White, and having fewer comorbid conditions. Models adjusted for demographic characteristics, geography, socioeconomic status, and a variety of medical diagnoses and comorbidities, but the paper does not comment on significance of these adjusters. Smith et al. suggest that differences in FFS and HMO patients may be attributable to the fact that FFS patients were more often discharged to inpatient rehabilitation facilities (IRFs) for additional, more intensive rehabilitation services than HMO patients who tended to be discharged home in their sample. Bueno et al. (2010) integrated patient demographics, history of cardiovascular disease, and other comorbidities into their study of almost 7 million male, FFS Medicare patients, 65 years of age or over, hospitalized for HF. The study found that although in-hospital and 30-day mortality rates decreased, 30-day all-cause readmission rates and post-hospital mortality risk increased over the study period from 1993 to 2006. The authors contended that FFS incentivizes shortening hospital LOS without penalizing unfavorable outcomes such as increased readmission and mortality rates.

7.3 Readmission Methods

In this section we describe the sample, dependent, and independent variable definitions.

7.3.1 Readmission Sample

The sample defined for this analysis was restricted to PAC patients with a Continuity Assessment Record and Evaluation (CARE) admission date occurring within 7 days after a short-stay acute discharge. The sample does not include all patients discharged from the hospital. By definition, it excludes cases not receiving PAC services and those beginning PAC services more than 7 days after leaving the hospital. The sample represents the cross-section of cases seen in the participating PAC settings. Thus, each PAC setting's population will originate from a variety of hospitals and will be impacted by those hospitals' referring and discharge practice patterns as well as the services they provide within their setting.

This decision was made to make the samples in the different provider types more clinically comparable by selecting patients who were at similar points in the trajectory of their PAC episodes, which could include services from multiple types of providers. For example, home health agency (HHA) providers are likely to be admitting patients later in the series of PAC services that the patient may be receiving after an acute stay; therefore, HHA readmission patterns would be impacted by different factors because they are further along in their recovery. An examination of the number of days between discharge from the prior acute stay and admission to the CARE provider revealed that the overwhelming majority of inpatient facility patients in the sample had been admitted directly from a prior short-stay acute hospitalization. Out of the patients with CARE admissions within 30 days of a prior acute discharge in our sample of IRFs, long-term care hospitals (LTCHs), and SNFs, 97.2, 97.7, and 94.5 percent of patients, respectively, had 0 days between the discharge date on their prior acute claim and the admission date on the claim corresponding to the PAC admission. However, only 45.3 percent of HHA patients were admitted within 1 day of a prior acute discharge. Because of this difference in the timing of patients CARE admissions, we decided to restrict the sample to just those patients with a CARE admission to one of the four PAC settings examined in this initiative within 7 days of a prior acute stay.

The sample for these models was further restricted to include only PAC CARE admissions where the PAC CARE admission assessment matched to a discharge or expired CARE assessment[1] to further select patients with similar trajectories of PAC use and clean data collected at admission and discharge. Patients who were discharged on an urgent or emergency basis were instructed to fill out an abbreviated version of the CARE tool. Thus, these patients were retained in our analytic sample. Patients admitted to a PAC setting within the 7 day period but who died during the 30 days after acute discharge without an intervening acute readmission were excluded from our sample because they were not at risk for the outcome (readmission) for the full follow-up period. To identify patients who died during the 30-day follow-up period, we obtained information on patients' date of death from the Medicare Enrollment Database, which is derived from the Social Security Administration Master Beneficiary Record. As in all analyses presented, cases that listed Medicare HMO as a payer were excluded from the sample.

The sample used in this analysis comes from the initial wave of data collection and consists of assessments collected between March 1, 2008 and April 30, 2010. In total, 9,557 PAC admissions were included in the analytic sample. The most common settings in our sample were IRFs (37.6 percent), followed by SNFs (28.7 percent), HHAs (13.3 percent), and LTCHs (20.4 percent).

7.3.2 Readmission Dependent Variable Definitions

The analyses profiled here focus on all-cause rehospitalizations occurring within 30 days of a prior hospital discharge. The 30-day follow-up period was selected for a variety of reasons. Studies show that readmissions are concentrated in the period after the initial acute discharge, making this time period of interest for efforts to improve quality and reduce adverse patient

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[1] If a patient had more than one PAC stay following separate acute discharges with a PAC admission and discharge assessment, both PAC stays could be in the sample.

outcomes. The Jencks et al. study (2009) cites that 19.6 of Medicare beneficiaries are readmitted within 30 days of acute care hospital discharge, with an additional 15 percent readmitted in the 31 to 90 days after the prior acute discharge. Readmissions occurring during this 30-day period also have been a focus for CMS's Nursing Home Quality Initiative and the Home Health Quality Initiative to encourage HHAs and SNFs to improve care practices and quality and to reduce rehospitalizations.

To create our outcome variable, we used Medicare claims to identify all patients who were readmitted for any reason to an acute care hospital within 30 days of the acute care hospital discharge prior to their CARE PAC admission. There was no restriction placed on the location of the patient at this time of readmission. The patient could be in a PAC setting or in the community after PAC discharge. The likelihood of the patient still being within the PAC setting at the time of discharge was correlated to the site of care and the typical length of stay for each setting.

We considered restricting our outcome definition to potentially avoidable rehospitalizations, as defined by the Agency for Healthcare Research and Quality (AHRQ) Prevention Quality Indicators (PQIs), which can be used to identify conditions for which good outpatient care can potentially prevent the need for hospitalization or for which early intervention can prevent complications or more severe disease.[2] The PQI conditions include acute care hospital readmissions for complications of diabetes, uncontrolled diabetes, lower-extremity amputation among diabetics, perforated appendix, hypertension, CHF, dehydration, bacterial pneumonia, urinary tract infection (UTI), angina, and exacerbations of adult asthma and COPD.[3] However, these were not developed on the PAC population and, as defined by AHRQ, were relatively rare (1.2 percent) in our sample. It is difficult to truly identify readmissions that are "preventable," and the appropriate set of conditions for our patient population has not yet been developed.[4] We, therefore, chose to use the broader set of all rehospitalizations.

With adequate control for patient-level characteristics that are associated with rehospitalization, it should be possible to examine the effect of facility characteristics and acute hospital discharge decisions on rehospitalization, even without the restriction to outcomes that are identified to be sensitive to health care service delivery, though the possibility of systematic differences in patient characteristics by provider type may remain. It should be noted that some rehospitalizations may be planned for follow-up procedures and not an indicator of higher acuity or poor quality. It should be noted that the severity of patient condition that may be expected to trigger a hospital readmission may vary systematically among PAC settings because of systematic differences in staffing levels and practice patterns associated with those PAC settings considered to be hospital-level care, those considered to be a skilled nursing level of care, and those considered to be intermittent care. For example, as LTCHs are certified as acute hospitals,

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[2] Additional information can be found at http://www.qualityindicators.ahrq.gov/TechnicalSpecs42.htm#PQI.

[3] Low birth weight is also included in the set of PQIs but is not relevant to this analysis.

[4] Limited work differentiating planned from unplanned readmissions was attempted through a technical expert panel involved in the 2009 Gage study; however, a clear list of planned admissions has not yet been developed for these populations.

the clinical change that would trigger readmission of a patient from an LTCH to an inpatient prospective payment system (IPPS) hospital is different than the clinical change that would trigger a readmission from an SNF to an acute (IPPS) facility.

7.3.3 Readmission Independent Variable Definitions

Please see Section 5 for a discussion of the independent variables tested in these models. Variables selected for testing included patient characteristics predictive of the type of PAC services that the patient would be receiving and also predictive of patient outcomes and resource utilization. Note that the independent variables were measured at each patient's CARE admission, except for the patient's primary medical diagnosis, which came from the Medicare claims corresponding to the acute discharge prior to the CARE admission, and the days since prior acute discharge, which were also based on claims. The CARE assessment offers a rich set of patient medical, cognitive, impairment, and functional items to control for patient variation not available on the hospital claims.

The independent variables include the patient demographics (age, gender, race), medical status (PAC admission days since prior acute stay, primary medical diagnosis in the preceding acute hospital, and comorbid conditions), cognitive status (Brief Interview for Mental Status [BIMS] without observational assessment information), impairments and functional status (bladder, bowel, swallowing, communication, respiratory status, and mobility endurance). A few of these factors are specific to this analysis and deserve additional discussion.

Comorbidities. Comorbidities in this analysis were based on the *International Classification of Diseases,* 9th revision (ICD-9) codes reported on the associated CARE discharge assessment form. The one exception was HHA comorbidities, which were based on the HHA admission assessment form to be consistent with their current coding practices. The ICD-9 codes were aggregated with the same logic used to create HCC scores in the Medicare program.

Days since prior admission. This variable identifies the number of days between the acute hospital discharge and the admission to the PAC setting.

Cognitive Status. Cognitive status is a composite measure based on the BIMS. BIMS is a measure of the patient's knowledge of day, month, and year. The analytic variable is coded into three groups: intact or borderline, moderately impaired, and severely impaired. The composite measure incorporates staff observation where the patient could not be interviewed. The severely impaired are defined by having had a sum score of less than "8" on the BIMS. Patients who did not have an interview and who were able to recall only one item, or who could recall two but could not recall that they were "in a hospital, nursing home, or home" on the observational assessment, were also considered to be severely cognitively impaired. Patients who scored from 8 to 12 on the BIMS or who could recall two items on the observational assessment, including that they were "in a hospital, nursing home, or home," were considered moderately impaired. The rest were considered "intact."

Functional Impairments. A subset of the functional impairments were included in the model. These were selected as indicators of patient frailty or worse health status. The impairments in the model for this chapter include the use of an indwelling or external bladder device; the need for assistance with a bowel device; and swallowing impairments as noted by "no intake by mouth" (NPO) status or having other signs or symptoms of swallowing difficulty, including coughing or choking during meals or when swallowing medications, holding food in mouth or cheeks or having residual food in mouth after meals, or loss of liquids/solids from mouth when eating or drinking. Communication deficits were measured as understanding verbal content "without cues or repetitions," usually understands, or sometimes understands (excluding verbal barriers).

The last two impairments controlled for respiratory status and mobility endurance. For the rehospitalization analysis, respiratory status was evaluated two ways: with supplemental oxygen (if appropriate) and without supplemental oxygen (if appropriate). Patients on a ventilator were considered separately. Impaired respiratory status was coded if the patient was on supplemental oxygen, or if not on oxygen, the patient was dyspneic or noticeably short of breath with minimal or less exertion. Mobility endurance was coded based on their ability to walk/wheel 50 feet. Four response options were provided on the item: could not do, could do with rest, could do without rest, and not assessed due to medical restriction.

7.4 Readmission Results

This section consists of three principal parts. First, the final readmission analysis sample is described with respect to the case-mix characteristics used in the models. Second, the unadjusted distribution of readmissions in the sample are presented, stratified by setting and case-mix characteristics. Third, the case-mix adjusted models are presented.[5]

7.4.1 Readmission Sample Description

This section presents the results of descriptive analyses characterizing the distribution of patients in this analysis of readmission.

Demographics by Setting. Tables 7-1 through **7-6** contain descriptive information about the overall sample of beneficiaries included in this readmission analysis. **Table 7-1** shows basic demographic information about the sample and patient characteristics prior to the current illness, exacerbation, or injury, including health service use. A majority of patients in our sample were over age 75 (59.9 percent), female (59.5 percent), and not Black or African American (99.6 percent) These characteristics were similarly distributed across settings in the sample, although the SNF sample did have a higher proportion of female patients (68.9 percent) and tended to be older (74.2 percent over age 75), compared with the overall sample and other settings. The variation in the days since prior acute discharge was primarily among HHA patients, even with the restriction to patients with an acute stay in the prior 7 days. Just 67.5 percent of patients in the HHA sample were admitted within 1 day of their prior acute stay, in contrast to 99.1, 98.9, and 97.9 percent of IRF, LTCH, and SNF patients, respectively, in the sample.

[5] Additional work was conducted under a related ASPE contract that examined survival curves in these four PAC settings (Morley et al., 2011).

Medical Status by Setting. The most common diagnosis grouping for the primary medical condition, as based on prior acute hospitalization, both overall and in the HHA and SNF settings, was major orthopedic surgery (overall: 12.1 percent; HHA: 10.7 percent; SNF: 18.7 percent) (see **Table 7-2**). However, only 1.3 percent of patients in LTCHs had this diagnosis. In that setting, the most common primary diagnosis was “respiratory, ventilator/tracheostomy” (32.4 percent). In the IRFs, the most common diagnosis group was stroke (16.4 percent); however, the second most common diagnosis was major orthopedic surgery (13.3 percent). Overall, about half of patients had a medical condition and half had a surgical condition treated in the prior acute discharge, with surgical discharges being more common in LTCHs and IRFs and medical discharges being more common in SNFs and HHAs.

Table 7-3 shows the distribution in our sample of categories of comorbidities found in the final acute readmission models. Metabolic, diabetes, and other endocrine disorders are the most common comorbidities shown, with 55.7 percent of the sample having a secondary diagnosis falling into this category. This was the most common set of comorbidities in each setting, except IRFs, where it was the second most common comorbidity. The next most common grouping of comorbidities in the overall sample was the set of orthopedic infections, rheumatoid arthritis, severe skeletal disorders, musculoskeletal conditions, and amputation (46.5 percent), which was the most common comorbidity in the IRF setting (61.0 percent). Notably, pneumonia, pleural effusion, and other respiratory conditions were more prevalent among LTCH patients (54.6 percent, compared with a range of 19 to 26 percent in the other PAC settings). Stroke as a comorbidity was more prevalent among IRF patients (20.7 percent, compared with a range of 2.8 to 8.5 percent in the other PAC settings). Major treatments were largely not retained in our predictive models, because they were only prevalent in the LTCH setting. Central line management was used in 59.4 percent of LTCH patients but was also somewhat prevalent among IRF patients (at 7.2 percent of the sample in that setting).

Cognitive Status by Setting. The majority of patients in the overall sample had intact or borderline cognitive abilities (59.8 percent). SNFs had the highest number of patients with severely impaired cognitive abilities, although LTCHs had the highest proportions of patients with these impairments (15.9 percent). LTCHs also had the highest proportion of patients who were not interviewed on the BIMS items (21.2 percent), likely largely driven by the higher proportion of patients who were on ventilators (see **Table 7-4**). HHAs and IRFs had the lowest proportion of patients with severe cognitive impairments (8.1 percent and 12.0 percent respectively).

Impairments by Setting. **Table 7-5** shows the proportion of patients with impairments in the analytic sample. Both bladder and bowel incontinence were more frequent in LTCHs than in the other PAC settings. LTCHs had 74.0 percent of patients who needed a bladder device, compared with 44.0 percent in IRFs, 8.2 percent in HHAs and 35.6 percent in SNFs. LTCHs had the highest proportion of patients with NPO (37.8 percent) compared with 3.1 percent for IRF. There were insufficient numbers in HHAs or SNFs in the sample to report. IRF patients had the highest proportion of patients with signs and symptoms of swallowing disorders, with 10.5 percent of patients exhibiting symptoms, which is a finding consistent with the high proportion of patients in IRFs with stroke diagnoses. LTCHs had the highest proportion of patients with a respiratory impairment (31.6 percent) and the highest with mobility endurance impairments (47.7 percent), defined as not being able walk or wheel 50 feet.

7.4.2 Readmission Descriptive Statistics

In this section, we present the percentage readmitted for all causes within 30 days of the prior acute discharge by each of the key covariates retained in the final models.

Readmissions by Setting and Demographic Items. Within the sample, unadjusted readmission rates within 30 days of hospital discharge were similar across provider types (**Table 7-6).** The overall rate of readmission in the sample was 19.2 percent. IRFs had the lowest proportion of patients in the sample who were readmitted (17.4 percent) followed by SNFs (19.8 percent), HHAs (20.2 percent), and LTCHs (21.1 percent). These rates are similar to previously published 30-day all-cause rates for Medicare beneficiaries (Jencks et al., 2009; Medicare Payment Advisory Committee [MedPAC], 2007). The rate for the SNFs in the sample is only slightly lower than the national rate reported previously for SNFs (23.5 percent in 2006) (Mor et al., 2010). A small proportion of the study sample did experience an acute readmission but died within the 30-day follow-up period (2.4 percent overall; rates were similar across provider type (HHA: 1.3 percent; IRF: 1.6 percent; LTCH: 2.7 percent; SNF: 3.6 percent).

Table 7-6 also shows the counts of patients who were excluded from the sample because they died during the follow-up period without an intervening hospital readmission. If these patients are included in the total count of deaths occurring during the follow-up period, LTCHs have a higher rate of mortality, with 10.9 percent of this expanded sample experiencing mortality, compared with 2.3 percent for HHA patients, 2.4 percent for IRF patients, and 3.5 percent for SNF patients. Preliminary analyses were conducted using an adverse outcome marker that included both readmissions and mortality to account for the higher rate of mortality among LTCH patients; however, the model findings were similar to the readmission-only models discussed below. We chose to retain the readmission-only outcome to maintain comparability with prior studies and quality improvement efforts ongoing across several settings. Results from prior studies have also suggested that readmission may be an outcome that is more modifiable by the quality of care being provided than mortality (Ross et al., 2008).

Readmission by Setting and Diagnoses. **Table 7-7** shows the most common diagnoses associated with readmission among the 1,836 readmissions that occurred during or following a CARE stay and within 30 days of a prior acute discharge in the overall sample. The diagnoses are aggregated into sets of related Medicare Severity Diagnosis Related Groups (MS-DRGs): MS-DRGs with major comorbidities and complications (MCC), MS-DRGs with comorbidities and complications (CC), and MS-DRGs without comorbidities and complications. Diagnoses are based on the discharge diagnosis listed on the acute readmission claims. Consistent with prior studies, HF and shock were the most common reasons for readmission in the overall sample, accounting for 5.5 percent of rehospitalizations, 7.4 percent of SNF readmissions, and 6.4 percent of IRF readmissions. The next most common reasons for short-stay acute readmission in the overall sample were septicemia without mechanical ventilation for more than 96 hours (5.3 percent) and COPD (3.5 percent). Within provider types, COPD was the most common reason for readmission from HHAs in the sample (9.7 percent).

Setting-specific bivariate analyses were performed to examine the characteristics of PAC patients with all-cause hospital readmissions within 30 days of hospital discharge. The next table (**Table 7-8**) shows the distribution of readmission in the sample by patient demographic characteristics. The rate of readmissions was similar across age groups, ranging from 18 to 20 percent. Readmission rates had the most variation by age among LTCH patients, where 19.9 percent of patients under 65 years of age were readmitted, compared with 22.9 percent of patients aged 65 to 74, 21.6 percent of patients aged 75 to 84, compared with 16.8 percent of patients over age 84. Males had higher readmission rates overall (21.8 percent compared with 17.4 percent of females) and in all settings. Readmission rates were higher overall for Black or African-American patients (21.9 percent) compared with non-Black patients (19.0 percent). As noted earlier, most patients were admitted to the PAC setting on the same day as they were discharged from the inpatient setting, and the number of transfers occurring after a zero-day gap did not allow for further comparative analysis.[6] Within HHA patients, a longer gap between leaving the acute hospital and beginning their home health episode was associated with higher rates of readmission (19.0 percent for a 1-day gap compared with 22.9 percent for a 2-day gap).

Readmission rates by primary medical diagnoses for the overall sample are shown in **Table 7-9.** Patients with an initial hospitalization diagnosis of kidney and urinary surgical (34.0 percent), COPD (31.1 percent), kidney and urinary medical (29.9 percent), and hematological medical conditions (29.3 percent) were rehospitalized proportionately more often than patients with other conditions in the sample. Looking at patients by major comorbidities (**Table 7-10**), it appears that among patients with UTI at admission as a comorbidity, HHA patients had proportionately more readmissions (29.2 percent) than the inpatient settings (IRF: 17.6 percent; SNF: 18.0 percent; LTCH: 16.9 percent). SNFs appeared to have the highest unadjusted rates of readmissions for patients in each of the selected comorbidities except for UTI, morbid obesity, orthopedic infection, and rheumatoid arthritis, for example. **Table 7-10** also shows the distribution of readmissions across provider types for patients with central line management (22.2 percent overall). IRF patients with central line management had the highest rates of readmission (27.0 percent) compared with SNF (25.6 percent) and LTCH (20.7 percent).

Readmission by Setting and Cognitive Status. In all of the inpatient PAC settings, patients who were found to be severely cognitively impaired as measured by BIMS at PAC admission (**Table 7-11**) were more likely to be readmitted (23.0 percent) than patients with only moderate cognitive impairment or whose cognitive status was intact. Among HHA patients, those with only moderate cognitive impairment (27.7 percent) were more likely to be readmitted compared with either those with severe impairment or no impairment, although the highest number of home health patients who were readmitted had their cognitive abilities intact or borderline. Patients who were not able to be interviewed due to being comatose, unresponsive, or minimally conscious, or who had a communication disorder, had the highest rates of readmission (24.0 percent).

Readmission by Setting and Impairments. **Table 7-12** shows the distribution of readmission by impairments and provider type. It appears that patients with bowel and bladder impairments had higher rates of rehospitalizations overall (21.2 percent of those needing assistance with a bowel device and 21.2 percent of those with an indwelling or external bladder device and across all PAC provider types). The differences in readmissions by presence of

[6] IRF and LTCH transfers all had 0-day gaps between PAC discharge and acute admission. HHA had very few readmissions after day 2 from discharge.

bowel and bladder impairments were much larger among the HHA and SNF patients than among the IRF and LTCH patients. Signs and symptoms of swallowing disorder were not associated with higher proportions of rehospitalization overall in these unadjusted analyses (19.7 percent of patients with signs and symptoms compared with 19.2 percent of patients with no signs and symptoms). Patients with NPO had higher rates of readmission overall (22.5 percent versus 18.9 percent). Readmissions were more common among SNF patients with swallowing disorder symptoms (27.4 percent) and patients with NPO (40.5 percent), compared with 19.4 percent of patients with no swallowing disorder signs and symptoms and 19.5 percent of the patients with NPO. Looking within the other provider types, IRF patients with signs and symptoms did not have different rates than patients without.

Patients with respiratory and mobility endurance impairments were also more likely to be readmitted than those patients without impairments across all settings (27.4 percent for respiratory impairments compared with 14.1 percent for no impairments; 22.2 percent for patients who could not tolerate walking or wheeling 50 feet, compared with 14.1 percent of patients who could without rest). SNFs had the highest proportion of patients with respiratory impairment who were rehospitalized (33.0 percent) among the PAC settings. Patients in the other settings with respiratory impairments had rates of readmission that ranged from 26.2 percent in HHAs to 25.0 percent in LTCHs. Patients who were not assessed on mobility endurance because of medical restriction had rates of readmission that were similar or higher than patients who had the most severe mobility impairments across settings, with IRF patients in this not-assessed category having the highest rates of readmission (30.1 percent). These are likely postsurgical patients who have medical orders restricting activity and who would also be at risk for complications that could return them to the short-stay acute care hospital.

7.4.3 Multivariate Models of Factors Associated with 30-Day All-Cause Readmission

This section describes the results of estimating multivariate models of 30-day all-cause readmissions. RTI developed logistic regression models to predict the impact of the provider type on risk for all-cause readmissions within 30 days of a prior acute discharge using the SAS command PROC SURVEYLOGISTIC, which fits linear logistic regression models for data based on complex sample design using pseudomaximum likelihood methods and incorporates the sample design into the analysis. Because patients in the same facility or receiving services from the same provider are likely to be more similar and receive more similar services than patients receiving services from different providers, the analyses took into account clustering at the provider level. We developed a single model predicting rehospitalization for all patients in our sample and four separate, condition-specific models predicting rehospitalization for four subsets of PAC patients that were analyzed in the other outcomes sections of this report: nervous system, circulatory, respiratory, and musculoskeletal conditions.

The independent variables used in this analysis include medical and functional characteristics, mood and cognition, and indicators of service utilization prior to the illness or exacerbation that resulted in the PAC stay. The goal of this analysis is to determine, among users of PAC services, whether one type of provider versus another is associated with the risk for hospital readmission after controlling for patient characteristics. In addition to setting indicators and patient acuity covariates, variables associated with days since prior acute discharge were included to control for variation attributable to the timing of the PAC CARE admission. The inclusion of time variables was based on the assumption that risk for readmission decreases over time since acute discharge.

Model-building methods included selection of variables that were confounders of the relationship between provider type and rehospitalization during or following a PAC admission and within 30 days of a prior hospital discharge. In other words, analyses were designed to identify variables predictive of all-cause rehospitalization and that also were predictive of where a patient might be receiving PAC services. To test these relationships empirically, we ran several simple regressions, entering our independent variables along with provider type one at a time or in groups capturing a single concept (e.g., cognitive impairment) as described in the independent variable list in Section 5. If the addition of a set of independent variables changed the coefficients on provider type by more than 5 percent, then that variable or concept was considered a confounder of the relationship between provider type and readmission and was retained in the model.

Model results are reported below as odds ratios (OR), which are the ratio of the odds of readmission for patients with a characteristic over the ratio of the odds of readmission for patients with the referent characteristic. ORs have been interpreted here as risk. An OR greater than 1.00 for a particular characteristic is associated with a greater likelihood, and an OR of less than 1.00 is associated with a lesser likelihood of being readmitted.

Two model fit statistics are presented in this section: the R-squared and the c-statistic. The R-square measures the proportion of the variation in the outcomes that is explained by the variables in the model. The scales range from 0 to 1 with higher numbers indicating more explanatory power. The c-statistic, which is frequently used to evaluate the performance of logistic regression, indicates the level of model discrimination between the sample population with the outcome of interest and without the outcome (readmission and no readmission). It is not a measure of goodness of fit. In this case, the measure compares the distribution of the predicted probabilities of readmission for the sample that was actually readmitted with the distribution of predicted probabilities of readmission for the sample that was not readmitted to see how well the model discriminates between these two groups of patients. When the predicted probabilities of being readmitted are higher for each patient in the sample who was readmitted than the predicted probabilities for the members of the sample who were not readmitted, the model has perfect discrimination and the c-statistic is equal to 1.0 (Ash and Shwartz, 1997). The measure ranges from 0.5 (no better than random assignment) to 1.0 (perfect prediction).

All Patients Model Predicting 30-Day All-Cause Readmission (n = 9,557). **Table 7-13** shows the results of the logistic regression model predicting acute care hospital readmission for all patients in the sample regardless of condition, for any reason within 30 days for our PAC sample. The multivariate model for predicting readmission within 30 days explained 4.9 percent of the variation when just patient characteristics at admission to the PAC setting were included. The c-statistic for this model was 0.66 indicating moderate discrimination among patients who were readmitted and those who were not based on the covariates included in the model. These model fit statistics are similar to those reported in previous studies (Keenan et al., 2000; Ross et al., 2008). It should be noted that the model was designed to estimate the impact of provider type on risk for readmission, not as a predictive model, in contrast to the purpose of the models to predict resource utilization in the later sections. The addition of the provider type indicators did not appreciably increase the explanatory power of the model. The R-square for patient acuity measures plus setting indicators was 5.1 percent and the c-statistic was unchanged.

Setting Indicators. Although the addition of setting indicators did not improve the explanatory power of the model, setting was a statistically significant predictor of readmission. The risk for readmission for HHA, IRF, and LTCH patients is compared to risk for SNF patients. After controlling for patient case-mix differences, we found that patients receiving services in LTCHs had a lower risk for readmission during the 30 days following discharge from the acute hospital than SNF patients after controlling for patient acuity (OR: 0.56, $p \leq 0.0001$). A lower readmission rate in LTCHs may be associated with LTCHs being certified as acute care hospitals and therefore better able to respond to patient changes in medical condition. Consequently, a clinical change necessary to require a short-stay acute readmission for LTCH patients is likely to be different than that of a SNF patient, all else equal.[7] In contrast, HHA and IRF patients had risks for readmission that were not significantly different than that of SNF patients after controlling for patient case-mix differences (HHA OR: 1.07, p = 0.70; IRF OR: 0.85, p = 0.15).

Patient Covariates at Admission. Influential patient covariates associated with increased risk for readmission include being in the lower age ranges of the sample (aged 64 years or under OR 1.24, p = 0.05); aged 65-74 OR: 1.28, p = 0.004). Medical diagnoses associated with higher risk include COPD (OR: 2.07, p = 0.01), both vascular and cardiac surgical diagnoses (cardiac OR: 1.79, p = 0.01; vascular OR: 1.89, p = 0.004), cardiac medical diagnoses (OR 1.72, p = 0.01), both surgical and medical kidney and urinary diagnoses (surgical OR: 2.62, p = 0.01; medical OR: 2.05, p = 0.001), and medical hematologic diagnoses (OR: 2.22, p = 0.08). Comorbidities associated with higher readmission rates are for metabolic, diabetes, and other endocrine disorders (OR: 1.14, p = 0.03); HF and shock, ischemic heart, and other vascular disease (OR: 1.15, p = 0.07), respiratory diagnoses, including pneumonia (OR: 1.15, p = 0.02); and acute and chronic renal diagnoses (OR: 1.30, p = 0.002). Patients with respiratory impairments were more likely to be rehospitalized than those without respiratory impairment (OR: 1.63, $p \leq 0.0001$).

Factors associated with fewer readmissions include being male (OR: 0.83, $p \leq 0.002$) and having orthopedic surgical conditions (minor OR: 0.77, $p \leq 0.0001$; major OR: 0.56, $p \leq 0.0001$) as the primary condition. Comorbidities present at PAC admission associated with lower risk for readmission include only UTI (OR: 0.83, p = 0.03). Additional factors associated with reduced rates include being cognitively intact, compared to patients with severe cognitive impairment (OR: 0.78, p = 0.01); NPO (OR: 0.77, p = 0.04); rarely understanding verbal content (OR: 0.51, p = 0.01); and higher motor function scores at admission (OR: 0.99, $p \leq 0.0001$).

Models Predicting 30-Day All-Cause Readmission in Selected Populations of Interest. RTI also conducted condition-specific analyses, investigating whether the risk for

[7] Additional work conducted under a related ASPE contract found that while LTCH cases were less likely than other PAC cases to be readmitted within the first 20 days of the discharge from the acute hospital, they have a higher probability by day 30 and beyond (Morley et al., 2011).

readmission varies by PAC provider type when looking at specific subgroups of patients as defined by medical condition. It was hypothesized that for different patient conditions, variables such as function or certain comorbidities might be more or less important for a patient's risk for readmission.

The condition groups examined include nervous system, respiratory, circulatory, and musculoskeletal. These condition groups were selected because they commonly receive PAC services and it is possible to find patients receiving services across a variety of PAC provider types. Patients were identified using the diagnoses found on the prior acute discharge claim. Nervous system conditions include the following categories: neurologic, stroke; neurologic, medical; and neurologic, surgical (Major Diagnostic Category 1 [MDC 1]). The respiratory condition group includes surgical, medical, COPD, and extracorporeal membrane oxygenation (ECMO) and tracheostomy patients (MDC 4 + ECMO/Trach). The circulatory system group includes vascular and cardiac surgical and medical conditions, and general cardiovascular diagnoses (MDC 5). The musculoskeletal condition group includes minor and major surgical procedures from the prior acute discharge, spinal diagnoses, and minor and major medical diagnoses (MDC 8). Combined, these four groups represent 74.3% of the population used in this analysis (see **Table 7-15**). Within settings, these conditions make up 66.8% of HHA cases, 83.7% of IRF cases, 68.3% of LTCH cases, and 69.9% of SNF cases. Each condition group includes a broad range of severity levels.

Tables 7-14 and **7-15** show the distribution of patients by provider type in the target conditions and the count of patients readmitted in each setting. Results from the regression analyses are shown in **Tables 7-16** through **7-19**.

<u>Nervous System Population: Models Predicting 30 Day All-Cause Readmission</u> (n = 1,378, readmissions = 209)**.** The IRFs in our sample have the largest proportion of nervous system patients in our data, with 28.4 percent of their population falling into this classification (see **Table 7-14**). Stroke makes up approximately 50 percent of the total of the nervous system categories in our population (**Table 7-3**). The unadjusted readmission rates in MDC 1 range from 18.0 percent in HHA to 14.4 percent in IRFs, 16.8 percent in SNF, and 18.1 percent in LTCHs.

For nervous system diagnoses (**Table 7-16**), we found no significant effect of provider type on risk for readmission after controlling for patient characteristics (HHA OR: 1.22, $p = 0.72$; IRF OR: 0.81, $p = 0.40$; LTCH OR: 0.70, $p = 0.35$). None of the settings had significantly different odds of rehospitalization than the SNF comparison group, including home health.

Male gender and comorbidities previously identified as predictive of lower risk for readmission in the overall sample were no longer significant in this subsample. Intact or borderline cognitive abilities (OR: 0.64, $p = 0.02$), moderate cognitive impairment (OR: 0.68, $p = 0.04$) along with NPO (OR: 0.72, $p = 0.08$) were associated with lower risk for readmission. It is likely that the association of NPO with lower risk for readmission is attributable to a high proportion of these patients being located in LTCHs. Acute and chronic renal comorbidities were associated with higher risk in this subsample (OR: 1.65, $p = 0.06$). Impaired respiratory status was also associated with a higher risk for readmission (OR: 1.88, $p = 0.01$). Higher motor function scores were associated with lower risk (OR: 0.98, $p \leq 0.01$).

The R2 and c-statistic for this analysis (0.04 and 0.64, respectively) indicate that the model has explained relatively little of the variation in rehospitalization in this subsample and has only moderate predictive power. These model diagnostic results, as noted for the overall sample, are very similar to those reported for other prior studies.

Respiratory Population: Models Predicting 30-Day All-Cause Readmission (n = 1,605, readmissions = 382). The LTCHs in our sample have the largest proportion of respiratory system condition patients, with 44.5 percent of LTCH patients. This is compared to 14.1 percent of HHA patients, 7.1 percent of IRF patients, and 11.1 percent of SNF patients. The respiratory system conditions were associated with fairly high rates of readmission (26.8 percent in HHA, 27.3 percent in IRF, 21.0 percent in LTCH, and 27.1 percent in SNF).

For respiratory diagnoses (**Table 7-17**), we found that LTCH (OR: 0.59, p = 0.02) patients were less likely to be readmitted than SNF patients, but that there was no difference in risk for HHA or IRF patients (HHA OR: 1.20, p = 0.52; IRF OR: 0.94, p = 0.80) than for SNF patients once patient characteristics were controlled for in the model.

Patients aged 75-84 years were at higher risk for readmission (OR: 1.51, p = 0.03). Patients with orthopedic diagnoses and UTIs listed as comorbidities were less likely to be readmitted (orthopedic OR: 0.76, p = 0.0.06; UTI OR: 0.60, $p \leq 0.003$). Impaired respiratory status was a significant predictor in the overall model and all subpopulation analyses of a higher risk for readmission (OR: 1.44, p = 0.03). Other factors associated with readmission for respiratory patients in the model include HF and other cardiac comorbidities (OR: 1.28, p = 0.10). Rarely or never understanding verbal content was associated with a lower risk for readmission, presumably weighted by the higher prevalence of this impairment in the LTCH population (OR: 0.31, p = 0.02). A higher motor function score at admission was associated with a reduced risk for readmission (OR: 0.98, $p \leq 0.004$).

The R2 and c-statistic for this analysis (0.05 and 0.65, respectively) indicate similar results to the other condition specific and overall models. As previously noted, these results are consistent with other prior studies.

Circulatory Population: Models Predicting 30-Day All-Cause Readmission (n = 1,487, readmissions = 376). Circulatory conditions were most common in HHA populations (where the home health episode followed a hospital stay within 7 days). Circulatory conditions made up 26.1 percent of HHA stays in this analysis compared to 12.7 percent of IRF patients, 13.7 percent of LTCH patients, and 15.7 percent of SNF patients. This condition was associated with unadjusted readmission rates of 23.2 percent in HHA, 26.0 percent in IRF, 23.6 percent in LTCH, and 27.2 percent in SNF.

For circulatory diagnoses (**Table 7-18**), we found that LTCH patients (OR: 0.51, p = 0.001) were less likely to be readmitted than SNF patients but that HHA and IRF patients (HHA OR: 1.19, p = 0.64; IRF OR: 0.79, p = 0.19) had risks that could not be differentiated from those of SNF patients once patient characteristics were controlled for in the model. Vascular surgical diagnoses as a primary medical condition were more likely to be readmitted compared to cardiac medical diagnoses (OR: 1.26, p = 0.01). Impaired respiratory status was also a significant predictor associated with a higher risk for readmission (OR: 1.67, p = 0.001). Patients who were not assessed on mobility endurance because of medical restriction were also at higher risk (OR: 1.58, p = 0.02), presumably because these are postsurgical patients who are at risk for complications. Higher motor function scores at admission were associated with a lower risk for readmission (OR: 0.99, $p \leq 0.02$).

The R2 and c-statistic for this analysis (0.04 and 0.63, respectively) are similar to the other condition-specific and overall models discussed above. These model diagnostic results, as previously noted, are not markedly different than those reported for other prior studies.

Musculoskeletal Population: Models Predicting 30-Day All-Cause Readmission (n = 2,635, readmissions = 323). Musculoskeletal conditions were common in all PAC settings except for LTCHs. This diverse group made up 19.6 percent of HHA stays in this analysis compared to 26.1 percent of IRF patients, 5.8 percent of LTCH patients, and 36.5 percent of SNF patients. Musculoskeletal conditions were associated with variable unadjusted readmission rates of 12.4 percent in HHA, 12.3 percent in IRF, 15.2 percent in LTCH, and 11.8 percent in SNF.

For musculoskeletal diagnoses (**Table 7-19**), we found that patients did not differ in their risk for readmission by the type of provider where they received PAC services (IRF OR: 0.81, p = 0.28; LTCH OR: 0.49, p = 0.14; HHA OR: 1.55, p = 0.27) compared to SNFs. As noted in the prior paragraph, in LTCHs the sample of patients with musculoskeletal conditions is small (5.8 percent).

Male patients were less likely to be rehospitalized (OR: 0.74, p = 0.02) than female patients. Patients with surgical primary diagnoses were less likely to have been readmitted than those in the reference group of major medical orthopedic diagnoses (minor surgical OR: 0.64, p = 0.04; major surgical OR: 0.51, $p \leq 0.0001$). Presumably this is because many of these procedures are planned and patients are therefore likely to have a higher baseline level of health and clinical stability than patients discharged with other diagnoses. Minor orthopedic medical diagnoses, however, were associated with higher risk for readmission than major medical (OR: 1.25, p = 0.01). Renal failure as a comorbidity increased the risk for readmission (OR: 1.87, p = 0.01) in addition to impaired respiratory status (OR: 1.51, p = 0.03) and having an indwelling or external bladder device (OR: 1.33, p = 0.07). As with the other subpopulations and the overall sample analyses, higher motor function scores at admission were associated with a lower risk for readmission (OR: 0.97, p = 0.0002).

The R-square and c-statistic for this analysis (0.04 and 0.67, respectively), are again consistent with the other condition-specific and overall models presented. These model diagnostic results, as previously noted, are not markedly different than those reported for other prior studies.

7.5 Discussion

These findings suggest that the receipt of PAC services from LTCH facilities is associated with lower risk for 30-day readmission once patient characteristics have been controlled for when compared to PAC services from SNFs. This is consistent with a prior study (Gage et al., 2009a) though important caveats should be considered in interpreting these findings, especially given subsequent analysis of survival rates examining time to readmission for this population in later days of the patient episodes (Morley et al., 2011). Patterns related to readmissions within 30 days should not be assumed to persist beyond 30 days.

Strengths of this analysis include a unique and rich source of patient-level clinical information from an assessment that was uniformly administered at admission for all patients across all the provider types included in the study. We have addressed potential bias in the length of time a patient is at risk for readmission by counting readmissions occurring at any point in the 30-day followup period, regardless of whether they occurred during the PAC stay. Examining only readmissions made directly from the PAC settings would have introduced bias due to systematic differences in length of stay by provider type. The sample also was selected to capture patients at similar points in their recovery after acute discharge by restricting to patients with acute care hospital discharges within 7 days of their PAC admission.

However, it is important to consider the potential for residual confounding of the relationship between provider type and risk for readmission. These models do not control for several factors that influence the type of provider from which patients may receive services. Geographic availability of PAC has been shown to be a predictor in prior studies (Gage et al., 2009a). Initial models, however, were tested with indicators of the availability of LTCH and IRF facilities in the Post-Acute Care Payment Reform Demonstration (PAC-PRD) market, and these were not found to be confounders or significant. Organizational relationships among the discharging acute care hospital and the admitting PAC settings also may be important and were not included in these models (Gage et al., 2009a).

Another potential issue is that patients receiving services from the different PAC types appear to be clinically very different on important predictors of readmissions. For example, patients with ventilator-related respiratory diagnoses and tracheostomy were almost exclusively found among LTCH patients. The lack of overlap among patients in the different provider types on key risk factors for readmission may be contributing to the poor model fit and ability to predict readmission. If an important risk factor was highly identified with a setting, it may not have been possible to control for it in the model. It is likely that the differences in the adjusted risk of readmissions by provider type are a reflection of unobserved variation in the factors that impact which patients are discharged to the different provider types. Patients who qualify for services in SNFs may just simply be different than those who are admitted to LTCHs.

While readmissions were validated using Medicare claims, we should also note that there is a potential undercount of LTCH readmissions because we relied on acute claims to identify readmissions. If an acute inpatient readmission from an LTCH is shorter than 3 days and the patient returned to the LTCH, no acute claim would have been included in the Medicare Provider Analysis and Review (MedPAR) file, as the LTCH is responsible for the cost of that acute readmission. This also would be true of the IRF admissions.

There was a concern that the lower readmission rate among LTCH patients may have been attributable to higher rates of mortality and systematic practice differences in transfers to acute before death. The strategy of excluding all patients who did not survive the 30-day follow-up period, rather than including them in the sample as patients who did not have a readmission, is an acceptable strategy for avoiding distortion in our calculations due to the prevalence of a competing risk. However, an additional set of models (not shown) was run predicting the combined outcome of readmissions and mortality occurring within 30 days from prior acute hospitalization. The results were very similar to what has been presented above, with the lower risk among LTCH patients still being found in the first 30 days after acute discharge.

A key consideration in interpreting the results must take into account that because IRFs and LTCHs are certified as acute care hospitals, the clinical change that would trigger readmission of a patient from an IRF or LTCH to an acute hospital is different than the clinical change that would trigger a readmission from a SNF to an acute hospital. This difference in the meaning of "readmission" for IRF and LTCH patients therefore may account, in large part, for the difference in risk for readmission observed for LTCH patients as compared to the other PAC settings, after controlling for patient characteristics. In contrast, home health cases are provided in a home-based setting, and a readmission could be triggered at a lower clinical cutoff than in an institutional setting.

Caution also should be exercised when interpreting the results of these models, for multiple additional reasons. The low R-squares for the models suggest a poor model fit, and the c-statistics, while they are consistent with other prior studies cited that were also in the 0.60 range (e.g., Keenan et al., 2008; Ross et al., 2008), do not indicate a strong ability to predict readmissions based on the patient characteristics included in the models. We should also note that these models are only designed to detect association and cannot be used to draw conclusions about causation or attribution. The Ross et al. review of 117 studies of readmission among HF patients suggests that the low discrimination of models, which widely relied on patient clinical characteristics to predict readmission (as we did in our analyses here) may indicate that facility characteristics may be more important in predicting risk for readmission. Goodness of fit of the models also may have been improved by use of more clinical information from the prior acute stay, which may have a large influence on patient-level risk for readmission or death, though our models do use the diagnosis from that stay. Ross et al. went on to observe that models using patient characteristics in their sample of studies to predict mortality did have somewhat better discrimination, suggesting that readmission more than mortality risk may be influenced by quality of care (Ross et al., 2008). While the above models do control for clustering of patients within facility, the weights do not currently adjust for oversampling of LTCH patients in the total sample.

Table 7-1
Administrative items and admission information, readmissions outcomes sample, overall and by provider type

Variable	Overall N	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Age										
64 years and under	1,125	11.8	173	13.6	398	11.1	403	20.7	151	5.5
65-74 years	2,712	28.4	367	28.8	1,130	31.4	658	33.8	557	20.3
75-84 years	3,571	37.4	463	36.4	1,362	37.9	654	33.6	1,092	39.8
85 years and above	2,149	22.5	270	21.2	704	19.6	232	11.9	943	34.4
Total	9,557	100.0	1,273	100.0	3,594	100.0	1,947	100.0	2,743	100.0
Gender										
Male	3,871	40.5	530	41.6	1,535	42.7	954	49.0	852	31.1
Female	5,686	59.5	743	58.4	2,059	57.3	993	51.0	1,891	68.9
Total	9,557	100.0	1,273	100.0	3,594	100.0	1,947	100.0	2,743	100.0
Race/ethnicity										
Black or African American	39	0.4	†	†	†	†	18	0.9	15	0.6
Non-Black	9,518	99.6	1,269	99.7	3,592	99.9	1,929	99.1	2,728	99.5
Total	9,557	100.0	1,273	100.0	3,594	100.0	1,947	100.0	2,743	100.0
Days from prior acute stay to PAC										
0 days	8,194	85.7	23	1.8	3,561	99.1	1,926	98.9	2,684	97.9
1 day	884	9.3	859	67.5	†	†	†	†	†	†
2 days	197	2.1	179	14.1	†	†	†	†	†	†
3 days	78	0.8	67	5.3	†	†	†	†	†	†
4 days	57	0.6	41	3.2	†	†	†	†	12	0.4
5 days	47	0.5	31	2.4	†	†	†	†	†	†
6 days	53	0.6	36	2.8	†	†	†	†	†	†
7 days	47	0.5	37	2.9	†	†	†	†	†	†
Total	9,557	100.0	1,273	100.0	3,594	100.0	1,947	100.0	2,743	100.0

† Indicates sample size of less than 11.

NOTE: HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

SOURCE: RTI analysis of initial collection of CARE assessments and Medicare claims data (care_cs373).

Table 7-2
Medical diagnosis grouping, combined prior acute and community entrants PAC claim, readmissions outcomes sample, overall and by provider type

Variable	Overall N	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Primary medical diagnosis groups[1]										
Neurologic, stroke	720	7.5	29	2.3	591	16.4	34	1.8	66	2.4
Neurologic, surgical	250	2.6	†	†	191	5.3	32	1.6	20	0.7
Neurologic, medical	411	4.3	53	4.2	242	6.7	18	0.9	98	3.6
Respiratory, ventilator and tracheostomy	735	7.7	†	†	77	2.1	630	32.4	20	0.7
Respiratory, surgical	112	1.2	20	1.6	36	1.0	30	1.5	26	1.0
Respiratory, medical	517	5.4	91	7.2	102	2.8	132	6.8	192	7.0
Respiratory, COPD	241	2.5	60	4.7	41	1.1	75	3.9	65	2.4
Cardiovascular, vascular surgical	271	2.8	36	2.8	119	3.3	67	3.4	49	1.8
Cardiovascular, cardiac surgical	475	5.0	121	9.5	177	4.9	80	4.1	97	3.5
Cardiovascular, general	198	2.1	45	3.5	41	1.1	34	1.8	78	2.8
Cardiovascular, vascular medical	53	0.6	12	0.9	14	0.4	†	†	18	0.7
Cardiovascular, cardiac medical	490	5.1	118	9.3	107	3.0	77	4.0	188	6.9
Orthopedic, minor surgical	722	7.6	40	3.1	385	10.7	53	2.7	244	8.9
Orthopedic, major surgical	1,154	12.1	136	10.7	479	13.3	26	1.3	513	18.7
Orthopedic, spinal	335	3.5	26	2.0	235	6.5	13	0.7	61	2.2
Orthopedic, minor medical	323	3.4	37	2.9	126	3.5	18	0.9	142	5.2
Orthopedic, major medical	117	1.2	†	†	56	1.6	†	†	46	1.7

(continued)

Table 7-2 (continued)
Medical diagnosis grouping, combined prior acute and community entrants PAC claim, readmissions outcomes sample, overall and by provider type

Variable	Overall N	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Integumentary, surgical	91	1.0	18	1.4	19	0.5	42	2.2	12	0.4
Integumentary, medical	146	1.5	25	2.0	20	0.6	35	1.8	66	2.4
Endocrine, surgical	33	0.4	†	†	12	0.3	†	†	†	†
Endocrine, medical	152	1.6	31	2.4	39	1.1	15	0.8	67	2.4
Kidney and urinary, surgical	53	0.6	†	†	12	0.3	†	†	23	0.8
Kidney and urinary, medical	318	3.3	63	5.0	74	2.1	40	2.1	141	5.1
Infections, surgical	118	1.2	13	1.0	29	0.8	60	3.1	16	0.6
Infections, medical	40	0.4	†	†	†	†	14	0.7	†	†
Infections, septicemia	273	2.9	25	2.0	44	1.2	113	5.8	91	3.3
Transplant	†	†	†	†	†	†	†	†	†	†
GI and hepatobiliary, minor surgical	147	1.5	31	2.4	36	1.0	27	1.4	53	1.9
GI and hepatobiliary, major surgical	202	2.1	35	2.8	42	1.2	71	3.7	54	2.0
GI and hepatobiliary, minor medical	173	1.8	32	2.5	38	1.1	31	1.6	72	2.6
GI and hepatobiliary, major medical	171	1.8	38	3.0	28	0.8	41	2.1	64	2.3
Hematologic, surgical	20	0.2	†	†	†	†	†	†	†	†
Hematologic, medical	82	0.9	21	1.7	18	0.5	12	0.6	31	1.1
Other, surgical	219	2.3	27	2.1	82	2.3	69	3.5	41	1.5
Other, medical	185	1.9	36	2.8	60	1.7	22	1.1	67	2.4

[1] Primary diagnosis is determined on the basis of the MS-DRG reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the PAC claim was grouped into an MS-DRG.

† Indicates sample size of less than 11.

NOTE: COPD = chronic obstructive pulmonary disease; GI = gastrointestinal bleeding; HHA = home health agency; IRF = inpatient rehabilitation facility; PAC = post-acute care; LTCH = long-term care hospital; SNF = skilled nursing facility.

SOURCE: RTI analysis of initial collection of CARE assessments and Medicare claims data (care_cs373).

Table 7-3
Top comorbid condition categories, readmission outcomes sample, overall and by provider type

Variable	Overall N	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Comorbid condition categories[1]										
Metabolic, diabetes, other endocrine (HCC21,23,24,17,18,19,20,26)	5,320	55.7	435	34.2	2,128	59.2	1,538	79.0	1,219	44.4
Orthopedic infection, rheumatoid arthritis, severe skeletal, musculoskeletal, amputation (HCC39,40,41,42,43,44,45,189)	4,446	46.5	314	24.7	2,192	61.0	726	37.3	1,214	44.3
Morbid obesity (HCC 22)	387	4.1	14	1.1	164	4.6	169	8.7	40	1.5
Head and spine injury (HCC166,167,70,71,72)	303	3.2	†	†	174	4.8	92	4.7	31	1.1
Heart failure and shock, ischemic heart disease, vascular (HCC84,86,87,106,107,108)	1,725	18.1	104	8.2	634	17.6	659	33.9	328	12.0
Stroke (HCC99,100,101,102,103,104)	1,126	11.8	36	2.8	745	20.7	166	8.5	179	6.5
Pneumonia, pleural effusion, other respiratory (HCC114,115,116,117,110,111, 112)	2,837	29.7	247	19.4	946	26.3	1,063	54.6	581	21.2
Acute and chronic renal (HCC135,136,137,138)	1,074	11.2	64	5.0	393	10.9	471	24.2	146	5.3
UTI (HCC141,144)	1,751	18.3	65	5.1	900	25.0	508	26.1	278	10.1
Major treatments										
Central line management	1,517	15.9	19	1.5	259	7.2	1,157	59.4	82	3.0
Total	9,557	100.0	1,273	100.0	3,594	100.0	1,947	100.0	2,743	100.0

[1] Comorbidities are based on the diagnoses listed on the CARE admission assessment.

† Indicates sample size of less than 11.

NOTE: HCC = hierarchical condition category; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility; UTI = urinary tract infection.

SOURCE: RTI Analysis of initial collection of CARE Assessments (care_cs373).

Table 7-4
Cognitive status, readmissions sample, overall and by provider type

Variable	Overall N	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Cognitive status (BIMS with observational assessment)[1]										
Cognitive abilities intact or borderline	5,713	59.8	916	72.0	2,126	59.2	919	47.2	1,752	63.9
Cognitive abilities moderately impaired	1,832	19.2	213	16.7	799	22.2	306	15.7	514	18.7
Cognitive abilities severely impaired	1,271	13.3	103	8.1	430	12.0	310	15.9	428	15.6
No interview, comatose, missing, or unresponsive/minimally conscious, communication disorder	741	7.8	41	3.2	239	6.7	412	21.2	49	1.8
Total	9,557	100.0	1,273	100.0	3,594	100.0	1,947	100.0	2,743	100.0

[1] Patients are considered to be severely cognitively impaired if they received a score of less than 8 on the Brief Interview for Mental Status (BIMS). Patients who did not receive an interview and who were only able to recall one item, or who could recall only two but could not recall that they were "in a hospital, nursing home or home" on the observational assessment of cognitive status were also considered to be severely cognitively impaired. Patients who scored from 8 to 12 on the BIMS or who could recall two items on the observational assessment including that they were "in a hospital, nursing home or home" were considered moderately impaired.

NOTE: BIMS = Brief Interview for Mental Status; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

SOURCE: RTI analysis of initial collection of CARE assessments (care_cs373).

Table 7-5
Impairments section, readmissions sample, overall and by provider type

Variable	Overall N	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Bladder: indwelling or external device used										
Yes	4,102	42.9	104	8.2	1,580	44.0	1,441	74.0	977	35.6
No	5,449	57.0	1,169	91.8	2,008	55.9	506	26.0	1,766	64.4
Missing	†	†	†	†	†	†	†	†	†	†
Total	9,557	100.0	1,273	100.0	3,594	100.0	1,947	100.0	2,743	100.0
Bowel: assistance needed with device										
Yes	2,714	28.4	54	4.2	1,118	31.1	1,195	61.4	347	12.7
No	6,837	71.5	1,219	95.8	2,470	68.7	752	38.6	2,396	87.4
Missing	†	†	†	†	†	†	†	†	†	†
Total	9,557	100.0	1,273	100.0	3,594	100.0	1,947	100.0	2,743	100.0
Swallowing: signs and symptoms of disorder present[1]										
Yes	623	6.5	27	2.1	376	10.5	96	4.9	124	4.5
No	8,934	93.5	1,246	97.9	3,218	89.5	1,851	95.1	2,619	95.5
Total	9,557	100.0	1,273	100.0	3,594	100.0	1,947	100.0	2,743	100.0
Swallowing: NPO—intake not by mouth										
Yes	897	9.4	†	†	112	3.1	735	37.8	†	†
No	8,654	90.6	1,265	99.4	3,476	96.9	1,212	62.3	2,701	98.5
Missing	†	†	†	†	†	†	†	†	†	†
Total	9,551	100.0	1,273	100.0	3,588	100.0	1,947	100.0	2,743	100.0
Understanding verbal content[2]										
Rarely/never	159	1.7	†	†	63	1.8	70	3.6	21	0.8
Frequently	788	8.3	54	4.2	337	9.4	207	10.6	190	6.9
Difficulty	1,914	20.0	238	18.7	876	24.4	355	18.2	445	16.2
Without difficulty	6,411	67.1	972	76.4	2,285	63.6	1,081	55.5	2,073	75.6
Unknown	285	3.0	†	†	33	0.9	234	12.0	14	0.5
Total	9,557	100.0	1,273	100.0	3,594	100.0	1,947	100.0	2,743	100.0

(continued)

Table 7-5 (continued)
Impairments section, readmissions sample, overall and by provider type

Variable	Overall N	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Respiratory status[3]										
Impaired	2,288	23.9	362	28.4	738	20.5	616	31.6	572	20.9
Not impaired	6,571	68.8	909	71.4	2,788	77.6	744	38.2	2,130	77.7
Not assessed/not applicable	203	2.1	†	†	62	1.7	106	5.4	33	1.2
Ventilator (weaning and non-weaning)	488	5.1	†	†	†	†	480	24.7	†	†
Missing	†	†	†	†	†	†	†	†	†	†
Total	10,767	100.0	1,970	100.0	3,695	100.0	2,153	100.0	2,949	100.0
Mobility endurance[4]										
No, could not do	3,433	35.9	177	13.9	1,376	38.3	929	47.7	951	34.7
Yes, can do with rest	1,943	20.3	526	41.3	595	16.6	169	8.7	653	23.8
Yes, can do without rest	3,211	33.6	501	39.4	1,455	40.5	276	14.2	979	35.7
Not assessed due to medical restriction	965	10.1	69	5.4	163	4.5	573	29.4	160	5.8
Missing	†	†	†	†	†	†	†	†	†	†
Total	9,557	100.0	1,273	100.0	3,594	100.0	1,947	100.0	2,743	100.0

1 Patients are considered to have symptoms of a possible swallowing disorder if the assessment was marked as “Coughing or choking during meals or when swallowing medications,” “holding food in mouth/cheeks or residual food in mouth after meals,” or “loss of liquids/solids from mouth when eating or drinking.”

2 The referent for understanding verbal content is “understands without cues or repetitions,” “usually understands,” or “sometimes understands.”

3 Patients are considered to have impaired respiratory status where respiratory status was evaluated while the patient was using supplemental oxygen and, for patients where status was only reported for activity without supplemental oxygen, if the patient was dyspneic or noticeably short of breath with minimal or less exertion. Patients on ventilators are included in a separate category.

4 Patients were evaluated on their ability to walk or wheel 50 feet (15 meters) to determine mobility endurance.

† Indicates sample size of less than 11.

NOTE: HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

SOURCE: RTI analysis of initial collection of CARE assessments (care_cs373).

Table 7-6
Unadjusted readmission and death, by provider type

Setting (sample count)	Percentage of sample readmitted in 30-day period	Percentage of sample readmitted who subsequently died in 30-day follow-up period	Total number including all deaths	Number of patients who died with no readmission	Percent mortality (out of total, including all deaths)
Total (N = 9,557)	19.2	2.4	9,874	317	5.5
HHA (n = 1,273)	20.2	1.3	1,285	12	2.3
IRF (n = 3,594)	17.4	1.6	3,624	30	2.4
LTCH (n = 1,947)	21.1	2.7	2,126	170	10.9
SNF (n = 2,743)	19.8	3.6	2,839	96	3.5

NOTE: HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

SOURCE: RTI analysis of initial collection of CARE assessments (care_cs374).

Table 7-7
Most common reasons for any all-cause acute readmissions, acute MS-DRG group, readmissions sample, overall and by provider type

MS-DRG Group	Overall N	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Heart failure and shock	101	5.5	†	†	40	6.4	†	†	40	7.4
Septicemia w/o MV 96+ hours	98	5.3	†	†	23	3.7	26	6.3	42	7.7
Chronic obstructive pulmonary disease	65	3.5	25	9.7	14	2.2	†	†	16	3.0
Simple pneumonia and pleurisy	64	3.5	†	†	20	3.2	†	†	26	4.8
Kidney and urinary tract infections	60	3.3	†	†	23	3.7	†	†	29	5.3
Renal failure	53	2.9	†	†	†	†	†	†	26	4.8
Cardiac arrhythmia and conduction disorders	50	2.7	†	†	20	3.2	†	†	20	3.7
Intracranial hemorrhage or cerebral infarction	49	2.7	†	†	28	4.5	†	†	†	†
Respiratory infections and inflammations	46	2.5	†	†	19	3.0	†	†	18	3.3
GI hemorrhage	42	2.3	12	4.7	12	1.9	†	†	†	†
Nutritional and misc metabolic disorders	42	2.3	†	†	17	2.7	†	†	†	†
Other circulatory system diagnoses	41	2.2	†	†	†	†	15	3.7	†	†
Esophagitis, gastroenteritis and miscellaneous digestive disorders	40	2.2	†	†	13	2.1	†	†	†	†
Respiratory system diagnosis with ventilator support <96 hours	36	2.0	†	†	†	†	19	4.6	†	†
Infectious and parasitic diseases with operating room procedure	36	2.0	†	†	13	2.1	15	3.7	†	†
Major gastrointestinal disorders and peritoneal infections	35	1.9	†	†	†	†	†	†	18	3.3
Pulmonary edema and respiratory failure	33	1.8	†	†	†	†	†	†	†	†
Peripheral vascular disorders	28	1.5	†	†	†	†	†	†	†	†
Septicemia w MV 96+ hours	25	1.4	†	†	†	†	22	5.4	†	†
Other digestive system diagnoses	24	1.3	†	†	†	†	†	†	†	†
Total	1,836	100.0	257	100.0	543	100.0	625	100.0	411	100.0

† Indicates sample size of less than 11.

NOTE: GI = gastrointestinal bleeding; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MS-DRG = Medicare Severity Diagnosis Related Group; MV = mechanical vent; SNF = skilled nursing facility.

SOURCE: RTI analysis of initial collection of CARE assessments (care_cs367).

Table 7-8
Administrative items and admission information, count and percentage readmitted, readmissions sample, overall and by provider type

Variable	Overall N readmitted	Overall % readmitted	HHA n readmitted	HHA % readmitted	IRF n readmitted	IRF % readmitted	LTCH n readmitted	LTCH % readmitted	SNF n readmitted	SNF % readmitted
Age										
64 years and under	226	20.1	42	24.3	73	18.3	80	19.9	31	20.5
65-74 years	544	20.1	72	19.6	205	18.1	151	22.9	116	20.8
75-84 years	677	19.0	89	19.2	235	17.3	141	21.6	212	19.4
85 years and above	389	18.1	54	20.0	112	15.9	39	16.8	184	19.5
Gender										
Male	845	21.8	111	20.9	302	19.7	237	24.8	195	22.9
Female	991	17.4	146	19.7	323	15.7	174	17.5	348	18.4
Race/ethnicity										
Black or African American	158	21.9	37	27.8	56	19.5	40	22.1	25	19.8
Non-Black	1,678	19	220	19.3	569	17.2	371	21	518	20.7
Days from prior acute stay to PAC admission										
0 days	1,565	19.1	†	†	621	17.4	409	21.2	530	19.7
1 day	169	19.1	163	19.0	†	†	†	†	†	†
2 days	44	22.3	41	22.9	†	†	†	†	†	†
3 days	19	24.4	16	23.9	†	†	†	†	†	†
4 days	19	33.3	15	36.6	†	†	†	†	†	†
5 days	†	†	†	†	†	†	†	†	†	†
6 days	†	†	†	†	†	†	†	†	†	†
7 days	†	†	†	†	†	†	†	†	†	†

† Indicates sample size of less than 11.

NOTE: HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

SOURCE: RTI analysis of initial collection of CARE assessments and Medicare claims data (care_cs373).

Table 7-9
Medical diagnosis grouping, combined prior acute and community entrants PAC claim, count and percentage readmitted, readmissions outcomes sample, overall and by provider type

Variable	Overall N readmitted	Overall % readmitted	HHA n readmitted	HHA % readmitted	IRF n readmitted	IRF % readmitted	LTCH n readmitted	LTCH % readmitted	SNF n readmitted	SNF % readmitted
Primary medical diagnosis groups[1]										
Neurologic, stroke	104	14.4	†	†	82	13.9	†	†	†	†
Neurologic, surgical	37	14.8	†	†	27	14.1	†	†	†	†
Neurologic, medical	68	16.5	†	†	38	15.7	†	†	20	20.4
Respiratory, ventilator and tracheostomy	165	22.4	†	†	18	23.4	136	21.6	†	†
Respiratory, surgical	21	18.8	†	†	†	†	†	†	†	†
Respiratory, medical	121	23.4	18	19.8	30	29.4	25	18.9	48	25.0
Respiratory, COPD	75	31.1	24	40.0	14	34.1	16	21.3	21	32.3
Cardiovascular, vascular surgical	77	28.4	†	†	35	29.4	17	25.4	16	32.7
Cardiovascular, cardiac surgical	120	25.3	28	23.1	45	25.4	22	27.5	25	25.8
Cardiovascular, general	41	20.7	†	†	†	†	†	†	16	20.5
Cardiovascular, vascular medical	†	†	†	†	†	†	†	†	†	†
Cardiovascular, cardiac medical	130	26.5	27	22.9	32	29.9	14	18.2	57	30.3
Orthopedic, minor surgical	91	12.6	†	†	49	12.7	†	†	33	13.5
Orthopedic, major surgical	100	8.7	†	†	43	9.0	†	†	42	8.2
Orthopedic, spinal	51	15.2	†	†	35	14.9	†	†	†	†
Orthopedic, minor medical	63	19.5	†	†	23	18.3	†	†	28	19.7
Orthopedic, major medical	20	17.1	†	†	†	†	†	†	†	†

(continued)

Table 7-9 (continued)
Medical diagnosis grouping, combined prior acute and community entrants PAC claim, count and percentage readmitted, readmissions outcomes sample, overall and by provider type

Variable	Overall N readmitted	Overall % readmitted	HHA n readmitted	HHA % readmitted	IRF n readmitted	IRF % readmitted	LTCH n readmitted	LTCH % readmitted	SNF n readmitted	SNF % readmitted
Integumentary, surgical	13	14.3	†	†	†	†	†	†	†	†
Integumentary, medical	22	15.1	†	†	†	†	†	†	12	18.2
Endocrine, surgical	†	†	†	†	†	†	†	†	†	†
Endocrine, medical	23	15.1	†	†	†	†	†	†	†	†
Kidney and urinary, surgical	18	34.0	†	†	†	†	†	†	†	†
Kidney and urinary, medical	95	29.9	15	23.8	17	23.0	14	35.0	49	34.8
Infections, surgical	33	28.0	†	†	†	†	13	21.7	†	†
Infections, medical	†	†	†	†	†	†	†	†	†	†
Infections, septicemia	66	24.2	†	†	†	†	25	22.1	28	30.8
Transplant	†	†	†	†	†	†	†	†	†	†
GI and hepatobiliary, minor surgical	31	21.1	†	†	†	†	†	†	†	†
GI and hepatobiliary, major surgical	42	20.8	†	†	12	28.6	13	18.3	†	†
GI and hepatobiliary, minor medical	37	21.4	†	†	12	31.6	†	†	13	18.1
GI and hepatobiliary, major medical	43	25.1	†	†	†	†	†	†	†	20.3
Hematologic, surgical	†	†	†	†	†	†	†	†	†	†
Hematologic, medical	24	29.3	†	†	†	†	†	†	†	†
Other, surgical	46	21.0	†	†	13	15.9	18	26.1	†	†
Other, medical	29	15.7	†	†	†	†	†	†	†	†

[1] Primary diagnosis is determined on the basis of the MS-DRG reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the PAC claim was grouped into an MS-DRG.
† Indicates sample size of less than 11.
NOTE: COPD = chronic obstructive pulmonary disease; GI = gastrointestinal bleeding; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; SNF = skilled nursing facility.
SOURCE: RTI analysis of initial collection of CARE assessments and Medicare claims data (care_cs373).

Table 7-10
Top comorbid condition categories, count and percentage readmitted, readmissions outcomes sample, overall and by provider type

Variable	Overall N readmitted	Overall % readmitted	HHA n readmitted	HHA % readmitted	IRF n readmitted	IRF % readmitted	LTCH n readmitted	LTCH % readmitted	SNF n readmitted	SNF % readmitted
Comorbid condition categories[1]										
Metabolic, diabetes, other endocrine (HCC21,23,24,17,18,19, 20,26)	1,103	20.7	93	21.4	405	19.0	319	20.7	286	23.5
Ortho infection, rheumatoid arthritis, severe skeletal, musculoskeletal, amputation (HCC39,40,41,42,43,44, 45, 189)	785	17.7	61	19.4	364	16.6	142	19.6	218	18.0
Morbid obesity (HCC22)	71	18.3	†	†	38	23.2	24	14.2	†	†
Head and spine injury (HCC166,167,70,71,72)	64	21.1	†	†	31	17.8	18	19.6	12	38.7
Heart failure and shock, ischemic heart disease, vascular (HCC84,86,87,106,107,108)	412	23.9	26	25.0	148	23.3	148	22.5	90	27.4
Stroke (HCC99, 100, 101, 102, 103, 104)	216	19.2	†	†	138	18.5	29	17.5	44	24.6
Pneumonia, pleural effusion, other respiratory (HCC114,115,116,117, 110, 111,112)	669	23.6	55	22.3	214	22.6	233	21.9	167	28.7
Acute and chronic renal (HCC135,136,137,138)	282	26.3	18	28.1	98	24.9	119	25.3	47	32.2
UTI (HCC141,144)	313	17.9	19	29.2	158	17.6	86	16.9	50	18.0
Major treatments										
Central line management	337	22.2	†	†	70	27.0	239	20.7	21	25.6

[1] Comorbidities are based on the diagnoses listed on the CARE admission assessment.

† Indicates sample size of less than 11.

NOTE: HCC = hierarchical condition category; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility; UTI = urinary tract infection.

SOURCE: RTI Analysis of initial collection of CARE Assessments (care_cs373).

Table 7-11
Cognitive status, count and percentage readmitted, readmissions sample, overall and by provider type

Variable	Overall N readmitted	Overall % readmitted	HHA n readmitted	HHA % readmitted	IRF n readmitted	IRF % readmitted	LTCH n readmitted	LTCH % readmitted	SNF n readmitted	SNF % readmitted
Cognitive status (BIMS with observational assessment)[1]										
Cognitive abilities intact or borderline	973	17.0	161	17.6	330	15.5	187	20.3	295	16.8
Cognitive abilities moderately impaired	393	21.5	59	27.7	146	18.3	66	21.6	122	23.7
Cognitive abilities severely impaired	292	23.0	19	18.4	92	21.4	72	23.2	109	25.5
No interview, comatose, missing, or unresponsive/minimally conscious, communication disorder	178	24.0	18	43.9	57	23.8	86	20.9	17	34.7

[1] Patients are considered to be severely cognitively impaired if they received a score of less than 8 on the Brief Interview for Mental Status (BIMS). Patients who did not receive an interview and who were only able to recall one item, or who could recall only two but could not recall that they were "in a hospital, nursing home or home" on the observational assessment of cognitive status were also considered to be severely cognitively impaired. Patients who scored from 8 to 12 on the BIMS or who could recall two items on the observational assessment including that they were "in a hospital, nursing home or home" were considered moderately impaired.

NOTE: BIMS = Brief Interview for Mental Status; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

SOURCE: RTI analysis of initial collection of CARE assessments (care_cs373).

Table 7-12
Impairments section, count and percentage readmitted, readmissions sample, overall and by provider type

Variable	Overall N readmitted	Overall % readmitted	HHA n readmitted	HHA % readmitted	IRF n readmitted	IRF % readmitted	LTCH n readmitted	LTCH % readmitted	SNF n readmitted	SNF % readmitted
Bladder: indwelling or external device used										
Yes	871	21.2	29	27.9	295	18.7	309	21.4	238	24.4
No	963	17.7	228	19.5	328	16.3	102	20.2	305	17.3
Missing	†	†	†	†	†	†	†	†	†	†
Bowel: assistance needed with device										
Yes	576	21.2	15	27.8	212	19.0	255	21.3	94	27.1
No	1,258	18.4	242	19.9	411	16.6	156	20.7	449	18.7
Missing	†	†	†	†	†	†	†	†	†	†
Swallowing: signs and symptoms of disorder present[1]										
Yes	123	19.7	†	†	64	17.0	19	19.8	34	27.4
No	1,713	19.2	251	20.1	561	17.4	392	21.2	509	19.4
Swallowing: NPO—intake not by mouth										
Yes	202	22.5	†	†	28	25.0	156	21.2	17	40.5
No	1,632	18.9	256	20.2	595	17.1	255	21.0	526	19.5
Missing	†	†	†	†	†	†	†	†	†	†
Understanding verbal content[2]										
Rarely/never	25	15.7	†	†	13	20.6	†	†	†	†
Frequently	186	23.6	12	22.2	70	20.8	52	25.1	52	27.4
Difficulty	395	20.6	61	25.6	149	17.0	77	21.7	108	24.3
Without difficulty	1,166	18.2	182	18.7	386	16.9	224	20.7	374	18.0
Unknown	64	22.5	†	†	†	†	51	21.8	†	†

(continued)

Table 7-12 (continued)
Impairments section, count and percentage readmitted, readmissions sample, overall and by provider type

Variable	Overall N readmitted	Overall % readmitted	HHA n readmitted	HHA % readmitted	IRF n readmitted	IRF % readmitted	LTCH n readmitted	LTCH % readmitted	SNF n readmitted	SNF % readmitted
Respiratory status[3]										
Impaired	627	27.4	95	26.2	189	25.6	154	25.0	189	33.0
Not impaired	1,057	16.1	162	17.8	412	14.8	142	19.1	341	16.0
Not assessed/not applicable	59	29.1	†	†	23	37.1	23	21.7	13	39.4
Ventilator (weaning and non-weaning)	92	18.9	†	†	†	†	92	19.2	†	†
Missing	†	†	†	†	†	†	†	†	†	†
Mobility endurance[4]										
No, could not do	756	22.0	66	37.3	263	19.1	198	21.3	229	24.1
Yes, can do with rest	386	19.9	104	19.8	101	17.0	35	20.7	146	22.4
Yes, can do without rest	452	14.1	68	13.6	211	14.5	40	14.5	133	13.6
Not assessed due to medical restriction	241	25.0	19	27.5	49	30.1	138	24.1	35	21.9
Missing	†	†	†	†	†	†	†	†	†	†

1 Patients are considered to have symptoms of a possible swallowing disorder if the assessment was marked as "Coughing or choking during meals or when swallowing medications," "holding food in mouth/cheeks or residual food in mouth after meals," or "loss of liquids/solids from mouth when eating or drinking."

2 The referent for understanding verbal content is "understands without cues or repetitions," "usually understands," or "sometimes understands."

3 Patients are considered to have impaired respiratory status where respiratory status was evaluated while the patient was using supplemental oxygen and, for patients where status was only reported for activity without supplemental oxygen, if the patient was dyspneic or noticeably short of breath with minimal or less exertion. Patients on ventilators are included in a separate category.

4 Patients were evaluated on their ability to walk or wheel 50 feet (15 meters) to determine mobility endurance.

† Indicates sample size of less than 11.

NOTE: HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

SOURCE: RTI analysis of initial collection of CARE assessments (care_cs373).

Table 7-13
All-Patients Model results predicting readmission for all patients

Parameter	Odds ratio	Lower confidence limit	Upper confidence limit	Pr > chi sq
Provider type				
HHA	1.07	0.75	1.53	0.70
IRF	0.85	0.68	1.06	0.15
LTCH	0.56	0.43	0.73	<.0001
SNF (referent)	1.00	—	—	—
Age				
64 years and under	1.24	1.00	1.53	0.05
65-74 years	1.28	1.08	1.51	0.004
75-84 years	1.10	0.94	1.28	0.23
85 years and above (referent)	1.00	—	—	—
Race/ethnicity				
Black/African American	1.08	0.87	1.33	0.49
Non-Black (referent)	1.00	—	—	—
Gender				
Male	0.83	0.74	0.94	0.002
Female (referent)	1.00	—	—	—
Days since prior acute discharge	1.00	0.93	1.07	0.92
Primary medical diagnosis groups[1]				
Neurologic, stroke	0.92	0.55	1.52	0.005
Neurologic, surgical	0.87	0.50	1.53	0.06
Neurologic, medical	1.05	0.61	1.83	0.23
Respiratory, ventilator and tracheostomy	1.18	0.72	1.94	0.47
Respiratory, surgical	0.97	0.52	1.79	0.20
Respiratory, medical	1.34	0.81	2.21	0.86
Respiratory, COPD	2.07	1.17	3.64	0.01
Cardiovascular, vascular surgical	1.89	1.16	3.08	0.004
Cardiovascular, cardiac surgical	1.79	1.13	2.85	0.01
Cardiovascular, general	1.38	0.78	2.44	0.80
Cardiovascular, vascular medical	0.82	0.34	1.98	0.19
Cardiovascular, cardiac medical	1.72	1.10	2.68	0.01
Orthopedic, minor surgical	0.77	0.47	1.27	<.0001
Orthopedic, major surgical	0.56	0.34	0.92	<.0001
Orthopedic, spinal	1.07	0.67	1.71	0.14
Orthopedic, minor medical	1.41	0.86	2.31	0.65
Orthopedic, major medical	1.21	0.64	2.28	0.76
Integumentary, surgical	0.93	0.45	1.95	0.22
Integumentary, medical	0.99	0.54	1.82	0.22
Endocrine, surgical	1.09	0.39	3.07	0.69
Endocrine, medical	0.91	0.48	1.76	0.15
Kidney and urinary, surgical	2.62	1.38	5.00	0.01
Kidney and urinary, medical	2.05	1.22	3.46	0.001

(continued)

Table 7-13 (continued)
All-Patients Model results predicting readmission for all patients

Parameter	Odds ratio	Lower confidence limit	Upper confidence limit	Pr > chi sq
Infections, surgical	1.80	1.02	3.17	0.13
Infections, medical	1.31	0.47	3.59	0.99
Infections, septicemia	1.43	0.87	2.36	0.54
Transplant	2.36	0.47	11.74	0.43
GI and hepatobiliary, minor surgical	1.41	0.78	2.52	0.77
GI and hepatobiliary, major surgical	1.40	0.86	2.28	0.71
GI and hepatobiliary, minor medical	1.58	0.90	2.77	0.29
GI and hepatobiliary, major medical	1.64	0.96	2.79	0.25
Hematologic, surgical	1.65	0.58	4.71	0.64
Hematologic, medical	2.22	1.10	4.49	0.08
Other, surgical	1.33	0.75	2.36	0.95
Other, medical (referent)	1.00	—	—	—
Comorbid condition categories[2]				
Metabolic, diabetes, other endocrine (HCC21,23,24,17,18,19,20,26)	1.14	1.01	1.28	0.03
Orthopedic infection, rheumatoid arthritis, severe skeletal, musculoskeletal, amputation (HCC39,40,41,42,43,44,45,189)	0.92	0.82	1.03	0.13
Morbid obesity (HCC22)	0.84	0.63	1.13	0.24
Head and spine injury (HCC166,167,70,71,72)	1.11	0.80	1.55	0.54
Heart failure and shock, ischemic heart disease, vascular (HCC84,86,87,106,107,108)	1.15	0.99	1.34	0.07
Stroke (HCC99,100,101,102,103,104)	1.01	0.83	1.24	0.90
Pneumonia, pleural effusion, other respiratory (HCC114,115,116,117,110,111,112)	1.15	1.03	1.29	0.02
Acute and chronic renal (HCC135,136,137,138)	1.30	1.10	1.53	0.002
UTI (HCC141,144)	0.83	0.71	0.98	0.03
Cognitive status (BIMS with observational assessment)[3]				
Cognitive abilities intact or borderline	0.78	0.64	0.94	0.01
Cognitive abilities moderately impaired	0.94	0.75	1.17	0.56
Cognitive abilities severely impaired (referent)	1.00	—	—	—
No interview, comatose, missing, or unresponsive/ minimally conscious, communication disorder	1.06	0.79	1.42	0.70
Major treatments				
Central line management	1.10	0.91	1.32	0.33
Bowel: assistance needed with device				
Yes	1.05	0.91	1.21	0.48
Bladder: indwelling or external device used				
Yes	1.02	0.87	1.20	0.80
Swallowing[4]				
Signs and symptoms of disorder present	0.90	0.71	1.15	0.39
Swallowing: NPO—intake not by mouth	0.77	0.60	0.99	0.04
No signs and symptoms or NPO (referent)	1.00	—	—	—

(continued)

Table 7-13 (continued)
All-Patients Model results predicting readmission for all patients

Parameter	Odds ratio	Lower confidence limit	Upper confidence limit	Pr > chi sq
Understanding verbal content[5]				
Rarely/never understands	0.51	0.30	0.86	0.01
Respiratory status[6]				
Impaired	1.63	1.43	1.86	<.0001
Mobility endurance[7]				
Yes, can do with rest	1.04	0.90	1.22	0.57
Cannot do, or can do with assistance (referent)	1.00	—	—	—
Not assessed due to medical restriction or missing	1.29	0.97	1.71	0.08
Function score[8]				
Motor independence at admission	0.99	0.98	0.99	<.0001

1 Primary diagnosis is determined on the basis of the MS-DRG reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the PAC claim was grouped into an MS-DRG.

2 Comorbidities are based on the diagnoses listed on the CARE admission assessment.

3 Patients are considered to be severely cognitively impaired if they received a score of less than 8 on the Brief Interview for Mental Status (BIMS). Patients who did not receive an interview and who were only able to recall one item, or who could recall only two but could not recall that they were "in a hospital, nursing home or home" on the observational assessment of cognitive status were also considered to be severely cognitively impaired. Patients who scored from 8 to 12 on the BIMS or who could recall two items on the observational assessment including that they were "in a hospital, nursing home or home" were considered moderately impaired.

4 Patients are considered to have symptoms of a possible swallowing disorder if the assessment was marked as "Coughing or choking during meals or when swallowing medications," "holding food in mouth/cheeks or residual food in mouth after meals," or "loss of liquids/solids from mouth when eating or drinking."

5 The referent for understanding verbal content is "understands without cues or repetitions," "usually understands," or "sometimes understands."

6 Patients are considered to have impaired respiratory status where respiratory status was evaluated while the patient was using supplemental oxygen and, for patients where status was only reported for activity without supplemental oxygen, if the patient was dyspneic or noticeably short of breath with minimal or less exertion. Patients on ventilators are included in a separate category.

7 Patients were evaluated on their ability to walk or wheel 50 feet (15 meters) to determine mobility endurance.

8 The function score is a continuous measure of a patient's independence in function, with a range from 1 (most dependent) to 100 (most independent).

NOTE: N = 9,557; R-squared = 0.05; c-statistic = 0.66. BIMS = Brief Interview for Mental Status; COPD = chronic obstructive pulmonary disease; GI = gastrointestinal bleeding; HCC = hierarchical condition category; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; SNF = skilled nursing facility; UTI = urinary tract infection.

SOURCE: RTI analysis of initial collection of CARE assessments and Medicare claims (care_cs371).

Table 7-14
Targeted conditions, readmission sample, overall and by provider type

Variable	Overall N	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Targeted conditions										
Diseases and disorders of the nervous system (MDC 1)	1,378	14.4	89	7.0	1,022	28.4	83	4.3	184	6.7
Diseases and disorders of the respiratory system (MDC 4) + ECMO/ tracheostomy	1,605	16.8	179	14.1	256	7.1	867	44.5	303	11.1
Diseases and disorders of the circulatory system (MDC 5)	1,487	15.6	332	26.1	458	12.7	267	13.7	430	15.7
Diseases and disorders of the musculoskeletal system and connective tissues (MDC 8)	2,635	27.6	250	19.6	1,273	35.4	112	5.8	1,000	36.5
Other conditions	2,452	25.7	423	33.2	585	16.3	618	31.7	826	30.1
Total	9,557	100.0	1,273	100.0	3,594	100.0	1,947	100.0	2,743	100.0

† Indicates sample size of less than 11.

NOTE: ECMO = extracorporeal membrane oxygenation; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MDC = major diagnostic category; SNF = skilled nursing facility.

SOURCE: RTI analysis of CARE data (care_cs373)

Table 7-15
Targeted conditions, count and percentage readmitted, readmissions sample, overall and by provider type

Variable	Overall N readmitted	Overall % readmitted	HHA n readmitted	HHA % readmitted	IRF n readmitted	IRF % readmitted	LTCH n readmitted	LTCH % readmitted	SNF n readmitted	SNF % readmitted
Targeted conditions										
Diseases and disorders of the nervous system (MDC 1)	209	15.2	16	18.0	147	14.4	15	18.1	31	16.8
Diseases and disorders of the respiratory system (MDC 4) + ECMO/ tracheostomy	382	23.8	48	26.8	70	27.3	182	21.0	82	27.1
Diseases and disorders of the circulatory system (MDC 5)	376	25.3	77	23.2	119	26.0	63	23.6	117	27.2
Diseases and disorders of the musculoskeletal system and connective tissues (MDC 8)	323	12.3	31	12.4	157	12.3	17	15.2	118	11.8
Other conditions	546	22.3	85	20.1	132	22.6	134	21.7	195	23.6

NOTE: ECMO = extracorporeal membrane oxygenation; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MDC = major diagnostic category; SNF = skilled nursing facility.

SOURCE: RTI analysis of CARE data

Table 7-16
Model results predicting readmission for patients discharged with nervous system conditions

Parameter	Odds ratio	Lower confidence limit	Upper confidence limit	Pr > chi sq
Provider type				
HHA	1.22	0.42	3.59	0.72
IRF	0.81	0.49	1.33	0.40
LTCH	0.70	0.33	1.48	0.35
SNF (referent)	1.00	—	—	—
Age				
64 years and under	1.11	0.59	2.08	0.75
65-74 years	1.28	0.75	2.18	0.36
75-84 years	1.02	0.64	1.62	0.94
85 years and above (referent)	1.00	—	—	—
Race/ethnicity				
Black/African American	1.26	0.84	1.89	0.27
Non-Black (referent)	1.00	—	—	—
Gender				
Male	0.80	0.53	1.21	0.29
Female (referent)	1.00	—	—	—
Days since prior acute discharge	1.09	0.84	1.40	0.52
Comorbid condition categories[1]				
Metabolic, diabetes, other endocrine (HCC21,23,24,17,18,19,20,26)	1.23	0.91	1.65	0.17
Orthopedic infection, rheumatoid arthritis, severe skeletal, musculoskeletal, amputation (HCC39,40,41,42,43,44,45,189)	1.08	0.81	1.44	0.60
Pneumonia, pleural effusion, other respiratory (HCC114,115,116,117,110,111,112)	1.14	0.83	1.57	0.41
Acute and chronic renal (HCC135,136,137,138)	1.65	0.97	2.81	0.06
Morbid obesity (HCC22)	1.42	0.69	2.92	0.34
UTI (HCC141,144)	1.23	0.84	1.80	0.30
Cognitive status (BIMS)[2]				
Cognitive abilities intact or borderline	0.64	0.44	0.94	0.02
Cognitive abilities moderately impaired	0.68	0.47	0.98	0.04
Cognitive abilities severely impaired (referent)	1.00	—	—	—
No interview, comatose, missing, or unresponsive/minimally conscious, communication disorder	0.99	0.60	1.63	0.96

(continued)

Table 7-16 (continued)
Model results predicting readmission for patients discharged with nervous system conditions

Parameter	Odds ratio	Lower confidence limit	Upper confidence limit	Pr > chi sq
Major treatments				
Central line management	0.98	0.49	1.94	0.95
Bowel: assistance needed with device				
Yes	0.98	0.66	1.46	0.93
Bladder: indwelling or external device used				
Yes	1.02	0.70	1.47	0.93
Swallowing[4]				
Signs and symptoms of disorder present	0.72	0.49	1.04	0.08
Swallowing: NPO—intake not by mouth	0.89	0.41	1.92	0.77
no signs and symptoms or NPO (referent)	1.00	—	—	—
Understanding verbal content[4]				
Rarely/never understands	0.48	0.20	1.19	0.11
Respiratory status[5]				
Impaired	1.88	1.19	2.97	0.01
Mobility endurance[6]				
Yes, can do with rest	1.12	0.71	1.78	0.62
Cannot do, or can do with assistance (referent)	1.00	—	—	—
Not assessed due to medical restriction or missing	1.60	0.55	4.65	0.39
Function score[7]				
Motor independence at admission	0.98	0.97	1.00	0.01

1 Comorbidities are based on the diagnoses listed on the CARE admission assessment.
2 Patients are considered to be severely cognitively impaired if they received a score of less than 8 on the Brief Interview for Mental Status (BIMS). Patients who did not receive an interview and who were only able to recall one item, or who could recall only two but could not recall that they were in a hospital, nursing home or home" on the observational assessment of cognitive status were also considered to be severely cognitively impaired. Patients who scored from 8 to 12 on the BIMS or who could recall two items on the observational assessment including that they were "in a hospital, nursing home or home" were considered moderately impaired.
3 Patients are considered to have symptoms of a possible swallowing disorder if the assessment was marked as "Coughing or choking during meals or when swallowing medications," "holding food in mouth/cheeks or residual food in mouth after meals," or "loss of liquids/solids from mouth when eating or drinking."
4 The referent for understanding verbal content is "understands without cues or repetitions," "usually understands," or "sometimes understands."
5 Patients are considered to have impaired respiratory status where respiratory status was evaluated while the patient was using supplemental oxygen and, for patients where status was only reported for activity without supplemental oxygen, if the patient was dyspneic or noticeably short of breath with minimal or less exertion. Patients on ventilators are included in a separate category.
6 Patients were evaluated on their ability to walk or wheel 50 feet (15 meters) to determine mobility endurance.
7 The function score is a continuous measure of a patient's independence in function, with a range from 1 (most dependent) to 100 (most independent).

NOTE: N = 1,378; R-squared = 0.04; c-statistic = 0.64. BIMS = Brief Interview for Mental Status; HCC = hierarchical condition category; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility; UTI = urinary tract infection.
SOURCE: RTI analysis of initial collection of CARE assessments and Medicare claims (care_cs371).

Table 7-17
Model results predicting readmission for patients discharged with respiratory conditions

Parameter	Odds ratio	Lower confidence limit	Upper confidence limit	Pr > chi sq
Provider type				
HHA	1.20	0.68	2.11	0.52
IRF	0.94	0.57	1.54	0.80
LTCH	0.59	0.38	0.92	0.02
SNF (referent)	1.00	—	—	—
Age				
64 years and under	1.22	0.72	2.06	0.46
65-74 years	1.30	0.89	1.91	0.17
75-84 years	1.51	1.04	2.18	0.03
85 years and above (referent)	1.00	—	—	—
Race/ethnicity				
Black/African American	1.17	0.72	1.90	0.52
Non-Black (referent)	1.00	—	—	—
Gender				
Male	0.72	0.53	0.96	0.02
Female (referent)	1.00	—	—	—
Days since prior acute discharge	0.88	0.74	1.05	0.15
Primary medical diagnosis groups[1]				
Respiratory, ventilator and tracheostomy	0.78	0.47	1.28	0.52
Respiratory, surgical	0.46	0.26	0.81	0.03
Respiratory, medical	0.69	0.48	1.00	0.86
Respiratory, COPD (referent)	1.00	—	—	—
Comorbid condition categories[2]				
Morbid obesity (HCC22)	0.68	0.38	1.20	0.18
Orthopedic infection, rheumatoid arthritis, severe skeletal, musculoskeletal, amputation (HCC39,40,41,42,43,44,45,189)	0.76	0.57	1.02	0.06
Heart failure and shock, ischemic heart disease, vascular (HCC84,86,87,106,107,108)	1.28	0.95	1.71	0.10
Stroke (HCC99,100,101,102,103,104)	0.86	0.50	1.46	0.57
Acute and chronic renal (HCC135,136,137,138)	1.22	0.80	1.86	0.37
UTI (HCC141,144)	0.60	0.42	0.84	0.003
Cognitive status (BIMS)[3]				
Cognitive abilities intact or borderline	0.97	0.58	1.61	0.89
Cognitive abilities moderately impaired	1.11	0.68	1.81	0.67
Cognitive abilities severely impaired (referent)	1.00	—	—	—
No interview, comatose, missing, or unresponsive/ minimally conscious, communication disorder	1.02	0.59	1.79	0.94
Major treatments				
Central line management	1.18	0.84	1.64	0.34
Bowel: assistance needed with device				
Yes	0.83	0.57	1.21	0.33

(continued)

Table 7-17 (continued)
Model results predicting readmission for patients discharged with respiratory conditions

Parameter	Odds ratio	Lower confidence limit	Upper confidence limit	Pr > chi sq
Bladder: indwelling or external device used				
Yes	1.02	0.70	1.48	0.92
Swallowing[4]				
Signs and symptoms of disorder present	0.95	0.56	1.61	0.84
NPO—intake not by mouth	0.67	0.38	1.18	0.16
No signs and symptoms or NPO (referent)	1.00	—	—	—
Understanding verbal content[5]				
Rarely/never understands	0.31	0.12	0.82	0.02
Respiratory status[6]				
Impaired	1.44	1.04	2.00	0.03
Not impaired (referent)	1.00	—	—	—
Mobility endurance[7]				
Yes, can do with rest	1.12	0.78	1.60	0.54
Cannot do, or can do with assistance (referent)	1.00	—	—	—
Not assessed due to medical restriction or missing	1.30	0.86	1.97	0.21
Function score[8]				
Independence in motor function at admission	0.98	0.97	1.00	0.004

1 Primary diagnosis is determined on the basis of the MS-DRG reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the post-acute care claim was grouped into an MS-DRG.

2 Comorbidities are based on the diagnoses listed on the CARE admission assessment.

3 Patients are considered to be severely cognitively impaired if they received a score of less than 8 on the Brief Interview for Mental Status (BIMS). Patients who did not receive an interview and who were only able to recall one item, or who could recall only two but could not recall that they were "in a hospital, nursing home or home" on the observational assessment of cognitive status were also considered to be severely cognitively impaired. Patients who scored from 8 to 12 on the BIMS or who could recall two items on the observational assessment including that they were "in a hospital, nursing home or home" were considered moderately impaired.

4 Patients are considered to have symptoms of a possible swallowing disorder if the assessment was marked as "Coughing or choking during meals or when swallowing medications," "holding food in mouth/cheeks or residual food in mouth after meals," or "loss of liquids/solids from mouth when eating or drinking."

5 The referent for understanding verbal content is "understands without cues or repetitions," "usually understands," or "sometimes understands."

6 Patients are considered to have impaired respiratory status where respiratory status was evaluated while the patient was using supplemental oxygen and, for patients where status was only reported for activity without supplemental oxygen, if the patient was dyspneic or noticeably short of breath with minimal or less exertion. Patients on ventilators are included in a separate category.

7 Patients were evaluated on their ability to walk or wheel 50 feet (15 meters) to determine mobility endurance.

8 The function score is a continuous measure of a patient's independence in function, with a range from 1 (most dependent) to 100 (most independent).

NOTE: N = 1,605; R-squared = 0.05; c-statistic = 0.65. BIMS = Brief Interview for Mental Status; COPD = chronic obstructive pulmonary disease; HCC = hierarchical condition category; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility; UTI = urinary tract infection.

SOURCE: RTI analysis of initial collection of CARE assessments and Medicare claims (care_cs371).

Table 7-18
Model results predicting readmission for patients discharged with circulatory conditions

Parameter	Odds ratio	Lower confidence limit	Upper confidence limit	Pr > chi sq
Provider type				
HHA	1.19	0.57	2.46	0.64
IRF	0.79	0.55	1.12	0.19
LTCH	0.51	0.35	0.74	0.001
SNF (referent)	1.00	—	—	—
Age				
64 years and under	1.37	0.84	2.24	0.20
65-74 years	1.17	0.79	1.75	0.44
75-84 years	1.04	0.75	1.46	0.81
85 years and above (referent)	1.00	—	—	—
Race/ethnicity				
Black/African American	0.95	0.61	1.48	0.82
Non-Black (referent)	1.00	—	—	—
Gender				
Male	1.05	0.80	1.39	0.74
Female (referent)	1.00	—	—	—
Days since prior acute discharge	0.91	0.80	1.05	0.18
Primary medical diagnosis groups[1]				
Cardiovascular, vascular surgical	1.26	0.89	1.81	0.01
Cardiovascular, cardiac surgical	1.13	0.83	1.54	0.08
Cardiovascular, general	0.83	0.52	1.33	0.69
Cardiovascular, vascular medical	0.49	0.23	1.01	0.05
Cardiovascular, cardiac medical (referent)	1.00	—	—	—
Comorbid condition categories[2]				
Morbid obesity (HCC22)	1.15	0.57	2.32	0.70
Head and spine injury (HCC166,167,70,71,72)	1.40	0.45	4.36	0.56
Pneumonia, pleural effusion, Other respiratory (HCC114,115,116,117,110,111,112)	1.24	0.96	1.60	0.11
UTI (HCC141,144)	1.22	0.81	1.85	0.34
Cognitive status (BIMS)[3]				
Cognitive abilities intact or borderline	0.82	0.53	1.27	0.37
Cognitive abilities moderately impaired	0.95	0.58	1.58	0.85
Cognitive abilities severely impaired (referent)	1.00	—	—	—
No interview, comatose, missing, or unresponsive/minimally conscious, communication disorder	0.98	0.49	1.95	0.95

(continued)

Table 7-18 (continued)
Model results predicting readmission for patients discharged with circulatory conditions

Parameter	Odds ratio	Lower confidence limit	Upper confidence limit	Pr > chi sq
Major treatments				
Central line management	1.29	0.85	1.97	0.23
Bowel: assistance needed with device				
Yes	1.12	0.79	1.58	0.54
Bladder: indwelling or external device used				
Yes	0.91	0.65	1.29	0.61
Swallowing[4]				
Signs and symptoms of disorder present	1.14	0.68	1.91	0.63
Swallowing: NPO—intake not by mouth	0.67	0.28	1.62	0.37
No signs and symptoms or NPO (referent)	1.00	—	—	—
Understanding verbal content[5]				
Rarely/never understands	0.70	0.20	2.47	0.58
Respiratory status[6]				
Impaired	1.67	1.25	2.25	0.001
Mobility endurance[7]				
Yes, can do with rest	1.17	0.87	1.57	0.29
Cannot do, or can do with assistance (referent)	1.00	—	—	—
Not assessed due to medical restriction or missing	1.58	1.09	2.30	0.02
Function score[8]				
Motor independence at admission	0.99	0.97	1.00	0.02

[1] Primary diagnosis is determined on the basis of the MS-DRG reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the post-acute care claim was grouped into an MS-DRG.

[2] Comorbidities are based on the diagnoses listed on the CARE admission assessment.

[3] Patients are considered to be severely cognitively impaired if they received a score of less than 8 on the Brief Interview for Mental Status (BIMS). Patients who did not receive an interview and who were only able to recall one item, or who could recall only two but could not recall that they were "in a hospital, nursing home or home" on the observational assessment of cognitive status were also considered to be severely cognitively impaired. Patients who scored from 8 to 12 on the BIMS or who could recall two items on the observational assessment including that they were "in a hospital, nursing home or home" were considered moderately impaired.

[4] Patients are considered to have symptoms of a possible swallowing disorder if the assessment was marked as "Coughing or choking during meals or when swallowing medications," "holding food in mouth/cheeks or residual food in mouth after meals," or "loss of liquids/solids from mouth when eating or drinking."

[5] The referent for understanding verbal content is "understands without cues or repetitions," "usually understands," or "sometimes understands."

[6] Patients are considered to have impaired respiratory status where respiratory status was evaluated while the patient was using supplemental oxygen and, for patients where status was only reported for activity without supplemental oxygen, if the patient was dyspneic or noticeably short of breath with minimal or less exertion. Patients on ventilators are included in a separate category.

[7] Patients were evaluated on their ability to walk or wheel 50 feet (15 meters) to determine mobility endurance.

[8] The function score is a continuous measure of a patient's independence in function, with a range from 1 (most dependent) to 100 (most independent).

NOTE: N = 1,487; R-squared = 0.04; c-statistic = 0.63. BIMS = Brief Interview for Mental Status; HCC = hierarchical condition category; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility; UTI = urinary tract infection.

SOURCE: RTI analysis of initial collection of CARE assessments and Medicare claims (care_cs371).

Table 7-19
Model results predicting readmission for patients discharged with musculoskeletal conditions

Parameter	Odds ratio	Lower confidence limit	Upper confidence limit	Pr > chi sq
Provider type				
HHA	1.55	0.71	3.42	0.27
IRF	0.81	0.55	1.19	0.28
LTCH	0.49	0.19	1.25	0.14
SNF (referent)	1.00	—	—	—
Age				
64 years and under	1.03	0.66	1.60	0.90
65-74 years	1.13	0.78	1.65	0.52
75-84 years	0.97	0.67	1.39	0.85
85 years and above (referent)	1.00	—	—	—
Race/ethnicity				
Black/African American	1.23	0.75	2.04	0.41
Non-Black (referent)	1.00	—	—	—
Gender				
Male	0.74	0.57	0.95	0.02
Female (referent)	1.00	—	—	—
Days since prior acute discharge	1.00	0.84	1.19	0.99
Primary medical diagnosis groups[1]				
Orthopedic, minor surgical	0.64	0.36	1.15	0.04
Orthopedic, major surgical	0.51	0.30	0.90	<.0001
Orthopedic, spinal	0.96	0.53	1.72	0.34
Orthopedic, minor medical	1.25	0.67	2.32	0.01
Orthopedic, major medical (referent)	1.00	—	—	—
Comorbid condition categories[2]				
Metabolic, diabetes, other endocrine (HCC21,23,24,17,18,19,20,26)	1.23	0.94	1.60	0.13
Heart failure and shock, ischemic heart disease, vascular (HCC84,86,87,106,107,108)	1.04	0.73	1.47	0.83
Stroke (HCC99,100,101,102,103,104)	1.22	0.76	1.96	0.42
Pneumonia, pleural effusion, other respiratory (HCC114,115,116,117,110,111,112)	1.14	0.84	1.55	0.41
Acute and chronic renal (HCC135,136,137,138	1.87	1.14	3.07	0.01
Morbid obesity (HCC22)	0.78	0.40	1.51	0.46
UTI (HCC141,144)	0.75	0.53	1.05	0.10
Cognitive status (BIMS)[3]				
Cognitive abilities intact or borderline	0.80	0.45	1.41	0.44
Cognitive abilities moderately impaired	0.92	0.56	1.52	0.75
Cognitive abilities severely impaired (referent)	1.00	—	—	—
No interview, comatose, missing, or unresponsive/minimally conscious, communication disorder	0.89	0.43	1.87	0.77

(continued)

Table 7-19 (continued)
Model results predicting readmission for patients discharged with musculoskeletal conditions

Parameter	Odds ratio	Lower confidence limit	Upper confidence limit	Pr > chi sq
Major treatments				
Central line management	1.53	0.87	2.67	0.14
Bowel: assistance needed with device				
Yes	0.95	0.74	1.22	0.68
Bladder: indwelling or external device used				
Yes	1.33	0.98	1.79	0.07
Swallowing[4]				
Signs and symptoms of disorder present	1.03	0.52	2.03	0.94
Swallowing: NPO—intake not by mouth	0.63	0.11	3.60	0.60
No signs and symptoms or NPO (referent)	1.00	—	—	—
Understanding verbal content[5]				
Rarely/never understands	0.38	0.07	2.16	0.27
Respiratory status[6]				
Impaired	1.51	1.05	2.17	0.03
Mobility endurance[7]				
Yes, can do with rest	0.95	0.70	1.30	0.76
Cannot do, or can do with assistance (referent)	1.00	—	—	—
Not assessed due to medical restriction or Missing	1.33	0.74	2.40	0.34
Function score[8]				
Motor independence at admission	0.97	0.95	0.98	0.0002

1 Primary diagnosis is determined on the basis of the MS-DRG reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the PAC claim was grouped into an MS-DRG.
2 Comorbidities are based on the diagnoses listed on the CARE admission assessment.
3 Patients are considered to be severely cognitively impaired if they received a score of less than 8 on the Brief Interview for Mental Status (BIMS). Patients who did not receive an interview and who were only able to recall one item, or who could recall only two but could not recall that they were "in a hospital, nursing home or home" on the observational assessment of cognitive status were also considered to be severely cognitively impaired. Patients who scored from 8 to 12 on the BIMS or who could recall two items on the observational assessment including that they were "in a hospital, nursing home or home" were considered moderately impaired.
4 Patients are considered to have symptoms of a possible swallowing disorder if the assessment was marked as "Coughing or choking during meals or when swallowing medications," "holding food in mouth/cheeks or residual food in mouth after meals," or "loss of liquids/solids from mouth when eating or drinking."
5 The referent for understanding verbal content is "understands without cues or repetitions," "usually understands," or "sometimes understands."
6 Patients are considered to have impaired respiratory status where respiratory status was evaluated while the patient was using supplemental oxygen and, for patients where status was only reported for activity without supplemental oxygen, if the patient was dyspneic or noticeably short of breath with minimal or less exertion. Patients on ventilators are included in a separate category.
7 Patients were evaluated on their ability to walk or wheel 50 feet (15 meters) to determine mobility endurance.
8 The function score is a continuous measure of a patient's independence in function, with a range from 1 (most dependent) to 100 (most independent).

NOTE: N = 2,635; R-squared = 0.04; c-statistic = 0.67. BIMS = Brief Interview for Mental Status; HCC = hierarchical condition category; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; SNF = skilled nursing facility; UTI = urinary tract infection.
SOURCE: RTI analysis of initial collection of CARE assessments and Medicare claims (care_cs371).

SECTION 8
OUTCOMES: FUNCTIONAL STATUS

Outcomes analyses, as noted in Section 7, are critical for understanding the efficacy of treatments provided. This section reports on functional outcomes achieved in post-acute care (PAC) settings, specifically in a long-term care hospital (LTCH), inpatient rehabilitation facility (IRF), skilled nursing facility (SNF), or home health agency (HHA). The standardized items available on the Continuity Assessment Record and Evaluation (CARE) tool allow systematic analysis of the type and degree of functional change achieved, if any, while consistently controlling for medical and cognitive status factors that may affect these outcomes. The dearth of uniform items to measure functional status across different PAC settings has previously restricted this type of analysis. Key to these discussions is the need for appropriate risk adjustment. Identifying the appropriate factors and controlling for them in a uniform manner, where appropriate, is important for critically analyzing and comparing outcomes between settings.

8.1 Functional Status Introduction

The inability to consistently measure functional status across different settings has been a key concern of Congress (Deficit Reduction Act of 2005), the Centers for Medicare & Medicaid Services (CMS) (Kramer and Holthaus, 2006), and the industry (Heinemann, 2007). The Administration's ability to measure function consistently across settings has been limited by the different functional items included in the mandated Inpatient Rehabilitation Facility Patient Assessment Instrument (IRF-PAI), Minimum Data Set (MDS), and Outcome and Assessment Information Set (OASIS) tools (Gage et al., 2006). As noted in Section 3, the three mandated assessment tools (IRF-PAI, MDS 3.0, OASIS-C) each include functional status measures. However, each uses different items to measure these concepts and different scales to assign degree of functional independence, and each assesses patients at different points in their admission. Standardizing these items and procedures across settings, as the CARE items have done, allows consistent measurement and analysis of functional status at admission and at discharge in each of these settings.

Therapy services are available in all four PAC sites – LTCHs, IRFs, SNFs, and HHAs. However, the amount of therapy provided and the complexity of the patients admitted to each setting may be influenced by the condition of participation requirements for each setting. For example, IRF patients must be able to receive and benefit from 15 hours of therapy a week. However, these patients may also be treated in either HHA, SNF, or LTCH settings and the amount and type of therapy received by similar patients in these settings may (or may not) vary. Understanding the degree to which patients are similar in their constellation of factors impacting functional improvement, including medical, functional, and cognitive status, is important in determining whether the four PAC settings are admitting subsets of similar patients and whether they achieve equivalent outcomes if treating similar patients.

This section provides information on how impaired beneficiaries are at admission to each setting, and whether functional outcomes differ when the same type of patient is treated in alternative PAC settings. Functional status is composed of several factors, including self-care, mobility, and cognition (Stineman et al., 1997). Expected outcomes in each of these three areas may differ across different types of populations, depending on the types of impairments associated with an illness or injury. Past researchers have used a variety of functional outcome measures, including change in functioning, functioning efficiency, and function at discharge after controlling for function at admission.

The analysis of functional change for this study focuses on factors associated with differences in self-care and mobility status and the degree to which they differ by PAC setting after controlling for patient acuity at the start of care. Self-care and mobility are examined separately in this work to allow differentiation of changes in motor scales (Stineman et al.,1996).

Functional change is defined as change in function from admission to discharge in a single setting. Functional change (or improvement) is an expected outcome of rehabilitation services in the Medicare program, so measuring it in a standard way across the various PAC settings that may provide therapy services is an important contribution of this demonstration.

8.2 Literature Review

A limited number of studies have focused on whether functional improvement is affected by the type of setting to which a patient is admitted. This research is limited both in the number of studies and the extent to which patient risk factors are controlled due to the absence of a uniform patient assessment and resource utilization tool across settings (Walsh & Herbold, 2006). Most of the studies have compared changes in functional outcomes associated with treatment in an IRF relative to treatment in a SNF or looked at factors explaining functional improvement within a single type of setting.

Several studies compared differences in outcomes between IRFs and SNFs for select groups of patients. Lenze et al. (2007) found that IRF patients with depression, apathy, or cognitive impairment showed significantly better functional recovery than did similarly impaired SNF patients. DeJong et al. (2009) found that while both IRF and SNF hip (n = 751) and knee replacement (n = 1,401) patients increased their motor FIM™ scores from admission to discharge, IRF patients had greater increases in their scores. In contrast, Deutsch et al. (2005) found that hip fracture patients with severe and moderate-to-severe disabilities fared better in terms of FIM™ scores when treated in SNFs than they did in IRFs, but there was no difference in the less severely disabled cases.

A key consideration in examining functional change is the need to appropriately risk adjust for differences in patient populations. Studies of risk factors for functional change among Medicare beneficiaries have focused on a range of patient characteristics, disease characteristics, and health care system dynamics. However, to date there is widespread disagreement over what constitutes the ideal methodological approach when it comes to constructing accurate predictive models for the purpose of appropriately risk adjusting for patient functional change.

Several studies have shown that a patient's preadmission functional condition affects functional outcomes during a patient's stay and need to be considered in the risk adjustments. Murtaugh et al. (2007) examined ADL and IADL changes associated with home health care. Using the Outcome Based Quality Improvement (OBQI) indicators to perform a logistic regression analysis of all home health agency (HHA) admissions in 2001 (n = 1,500,000), the authors found that performance on prior activities of daily living (ADL) and instrumental activities of daily living (IADL) were significant predictors of ADL and IADL improvement. The authors developed their own risk adjustment model that also showed a strong correlation between preadmission functional scores and functional improvements. Lieberman et al. (2006) also found that preadmission functional scores were a significant predictor of functional outcomes for 946 hip fracture patients in Israel.

Prior disability and functional status at time of admission are important predictors of related functional outcomes in the IRF populations also. Stineman et al.(2003) studied over 218,000 IRF patients stratified by primary central nervous system impairments, spinal cord injury, other neurological conditions, musculoskeletal conditions, diagnoses that tend to reduce endurance (cardiopulmonary and pain) and other conditions. Prolonged time since onset of disability (a marker of preadmission disability) even after adjusting for admission scores on the functional independence measure, (FIM™) and multiple medical and demographic factors remained strongly and independently associated with lower likelihood of achieving a high grade of physical functioning by discharge. Those whose disability onsets were from 4-6 months earlier and more than 6 months earlier than IRF admission had lower odds (adjusted odds ratio [OR]: 0.48; 95% confidence interval [CI]: 0.41-0.57 and OR: 0.41; 95% CI: 0.37-0.45, respectively) of reaching a higher stage of physical functioning by discharge than those whose disability onset was within 2 weeks of IRF admission (Stineman, et al., 2003). Additional studies have found similar negative relationships between function at admission and discharge function (Kramer et al., 1997, DeJong et al., 2009, Munin et al., 2005, Buntin et al., 2010, Deutsch et al., 2005, Kane et al., 2000, Walsh and Herbold, 2006, Gage, Bernard, et al., 2005).

Cognitive scores and mental status at admission also have been shown to be related to functional improvement for patients. In general, more cognitive impairment and depression were associated with less functional improvement. Heruti et al. (2002) found that cognitive impairment at admission was negatively correlated with functional improvement in a study of 315 stroke patients in IRFs. Berner et al. (2004) found that rehabilitation patients who scored better on the Clock Completion Test (CCT), a test of cognitive ability, had higher Mini Mental State Exam (MMSE) and FIM™ discharge scores than patients who did not score well on the CCT. Cornette et al. (2005) found that cognitive impairment had a negative relationship with functional admission scores. Givens et al. (2008) looked at whether depression, cognitive impairment, or delirium had an effect on functional recovery for hip fracture patients. The authors found that the stepwise addition of a cognitive disorder to a patient's preexisting risk increased the odds of a decline in ADL function, a loss of ambulation, and nursing home placement or death; however, the authors found that none of the cognitive disorders significantly predicted adverse functional scores after 6 months. Lenze et al. (2007) found that depression and mild cognitive impairment were not related to functional status in hip fracture patients; patients discharged with one of these cognitive disorders scored as well as other elderly hip fracture patients. In a study of 393 patients with delirium in SNFs, Kiely et al. (2006) found that patients whose delirium resolved within 2 weeks had better-than-baseline functional scores, whereas patients whose delirium did not resolve before the 6-month followup scored only around half of their functional baseline score.

Other factors that have a negative relationship with functional improvement include age (Boyd et al., 2008; Chin et al., 2008; Cornette et al., 2005; Ottenbacher et al., 2008); pain scores at admission (Chin et al., 2008); presence of cardiovascular disease, dementia, cancer, and low albumin (Boyd, 2008); the amount of age-related white matter in the brain (Inzitari et al., 2007); falls in the prior year (Cornette et al., 2005); and the amount of daytime sleep a patient receives (Alessi et al., 2008).

A number of researchers have examined predictors of functional improvement in subpopulations of interest such as stroke. Ottenbacher et al. (2008) used Uniform Data System for Medical Rehabilitation (UDS_{MR}®)[8] data to compare functional outcomes for stroke patients (n = 178,055) by race and ethnicity. The authors found that length of stay was consistent across racial and ethnic groups; however, non-Hispanic White patients had higher admission and discharge FIM™ scores than did other groups, indicating more independence. Age was also found to be an important predictor of functional scores across various groups, as non-Hispanic White patients scored 8 FIM™ points higher, on average, than did Hispanics, among the oldest patients.

Factors associated with functional improvement among patients with orthopedic conditions were slightly different, including age, comorbidities, rehabilitation participation, fracture location for patients with hip fractures, cognitive status, admission functional status and social networks (Kramer 1997, DeJong 2009, Munin 2005, Buntin 2010, Deutsch 2005, Kane 2000, Walsh 2006.)

8.3 Functional Improvement Methods

Our approach consisted of constructing risk adjusted models of functional change, specifically, change in mobility and change in self-care from admission to discharge within a PAC setting. Proc SurveyReg was used to predict functional change associated with a PAC admission while controlling for clustering within providers. Functional change was based on the mobility and self-care scales derived from items on the CARE tool as discussed in Section 5 of this report. The analyses presented in this chapter attempt to control for many factors affecting patient status at admission, including function at admission, medical complexity factors (major medical procedures, stage 3 or 4 pressure ulcers, anemia, etc.), impairments (shortness of breath, sitting endurance, incontinence, etc.), and functioning prior to the current spell of illness.

8.3.1 Functional Improvement Sample

The sample used in this analysis comes from the initial wave of data collection and consists of assessments collected between March 1st 2008 and April 30th 2010. There was no restriction placed on the sample related to proximity of the PAC stay to the acute hospital stay. The sample for this analysis contains a mixture of PAC stays representing direct transfers from an acute facility, subsequent PAC admissions and community admits, where relevant.

The sample for these models included patients who had PAC stays that had a matched admission and discharge assessment for the same stay and did not have an unexpected discharge. Unexpected discharges typically occur when the patient is transferred to the hospital without prior planning. Because of the urgent nature of these discharges, the performance-based

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[8] UDS_{MR}® is a trademark of Uniform Data System for Medical Rehabilitation, a division of UB Foundation Activities, Inc.

functional measures are commonly missing. By eliminating unexpected discharges, this sample may be eliminating the most clinically unstable portion of the population. This group was retained in other analyses but considered inappropriate for functional change outcomes since their treatment was incomplete at the time of discharge. In all, 1,957 cases, or approximately 14 percent of the paired admission and discharge sample, were excluded because of an unexpected discharge record: 542 cases were excluded for having listed Medicare health maintenance organization (HMO) as a payer on the assessment, 396 cases were excluded because the patient expired during the stay, and 652 cases were excluded because the patient had more than one admission or discharge record per stay.

We excluded cases where either the discharge or admission functional performance assessment data were missing. For the self-care model, 49 cases were excluded because the assessments did not have an admission self-care function score, and 184 cases were excluded because the assessments had no patient-stay matched discharge score. For the mobility model, 26 cases were excluded because the assessments did not have an admission mobility score, whereas 185 cases were excluded for having no patient-stay matched discharge mobility score.

For the self-care analyses, the final sample of 12,065 patients included 3,190 HHA patients, 4,158 IRF patients, 1,968 LTCH patients, and 2,749 SNF patients. For the mobility analyses, the final sample of 12,080 patients included 3,190 HHA patients, 4,158 IRF patients, 1,968 LTCH patients, and 2,749 SNF patients.

8.3.2 Functional Improvement Dependent Variable Definitions

The dependent variables for this analysis consists of two separate functional outcomes measures: change in a patient's ability to perform self-care activities, and change in a patient's ability to perform mobility activities.

Self-care change and mobility change were created by calculating the change from admission to discharge in a patient's composite function Rasch measures.[9] These Rasch measures combine a patient's scores on a set of CARE tool function items into a single continuous subscale measure with a range from 0 to 100, with 0 being the most dependent and 100 being the most independent. The self-care Rasch measure and the mobility Rasch measure are based on two different sets of CARE items that have been arrayed along a single scale or "ruler" indicating a patient's independence in function:

- **Self-Care Change.** The self-care measure is based on a patient's level of independence on the following CARE items: eating, oral hygiene, toilet hygiene, dressing upper body, dressing lower body, putting on and removing footwear, washing upper body, and showering/bathing self.

- **Mobility Change.** The mobility measure is based on a patient's level of independence on the following CARE items: lying to sitting on side of bed; sit to

[9] See Section 5 for a discussion of the Rasch measure development from the raw function scores. Rasch results were similar to the raw score tests but also allowed retention of cases missing selected items from the function subscales.

stand; chair or bed-to-chair transfer; toilet transfer; car transfer; rolling left and right; sit to lying; picking up objects; taking 1, 4, and 12 steps (interior/exterior); walking 10 feet on uneven surfaces; and walking 50 feet with two turns.

For the purposes of this analysis, change scores are calculated from admission to discharge within a single PAC setting. The time between the two observation points is directly related to the length of stay and length of stay varies systematically by provider setting. Stay level analyses are important for understanding the overall relative efficacy of treatment in different PAC settings. For home health patients, the stay represents the entire time a patient is treated by a specific home health agency and may encompass multiple 60-day home health episodes. Information on the distribution of length of stay can be found in **Table 8-1**. The sample being examined represent a cross section of the patients treated in the four PAC settings. Individual admissions may be immediately following a hospital stay, care obtained during a subsequent PAC stay, or even care which does not follow a hospital stay but that is provided in one of the PAC settings.

8.3.3 Functional Improvement Independent Variable and Covariate Definitions

The goal of this analysis is to determine, after holding patient characteristics equal, if patient outcomes differ by the type of provider supplying PAC services. The key independent variable of interest for this analysis is the type of PAC provider. Additional covariates in this analysis include medical and functional characteristics, mood and cognition, and indicators of prior utilization as described in the conceptual model section (Section 5).

8.4 Analytic Sample Description

The analytic discussion consists of three principal parts. First, the analysis sample is described with respect to the case-mix characteristics used in the models. Second, the unadjusted distribution of self-care and mobility improvement in the sample are presented, stratified by setting and case-mix characteristics. Third, the case-mix adjusted models are presented. We conducted descriptive analyses to characterize the patients in this analysis of change in self-care functioning and change in mobility. This analysis is based on 12,065 cases, of which 26.4 percent were treated in HHAs, 34.5 percent in IRFs, 16.3 percent in LTCHs, and 22.8 percent in SNFs **(Table 8-1**). The average length of stay varied by setting: HHA stays tended to be longest (52 percent of all cases were longer than 30 days) while the shortest stay cases were in IRFs (over 63 percent were shorter than 14 days), followed by SNFs (41 percent were shorter than 14 days).

Demographics by Setting. The majority of all patients were over age 65 and female, although HHAs and SNFs had higher proportions of female patients (over 65 percent each) than did IRFs and LTCHs, where females accounted for lower shares of admissions **(Table 8-2)**. The race of patients in all four settings reflected the Medicare population in general, with White patients accounting for 87.2 percent of the HHA admissions, 87.7 percent of the IRF admissions, 92.0 percent of the SNF admissions, and 82.5 percent of the LTCH admissions. Medicaid was a secondary payer in seven percent of the cases, overall.

Preadmission Use. Almost all patients treated in the three inpatient PAC settings (IRFs, LTCHs, SNFs) were admitted from the hospital (about 93 percent). However, only 37.3 percent of the HHA patients were admitted directly from the hospital; the rest were admitted from an SNF (18.2 percent) or directly from the community (29.0 percent). Still, 66.9 percent of the HHA cases had a prior hospitalization in the past 2 months.

Preadmission Functional Status. LTCH populations had the greatest dependence levels prior to the admission with 11.6 percent of the cases being totally dependent in self-care although HHA cases also tended to have the greatest proportions of those needing partial assistance in self-care prior to admission (31.8 percent), followed closely by SNFs (26.9 percent) and LTCHs (26.2 percent). IRF patients were most likely to have been independent prior to this current illness, exacerbation or injury. These patterns were also largely true for mobility status prior to admission although LTCH admissions were slightly more impaired in mobility than SNF admissions. About one-third of the sample used a wheelchair, scooter, or other wheeled mobility device to move from room to room prior to this current illness, exacerbation or injury.

Medical Status by Setting. The sample varied on the types of medical conditions identified as the primary reason for treatment. Most conditions were seen in at least two settings **(Table 8-3)**. IRFs and SNFs had a larger proportion of their cases admitted for therapy intensive conditions, such as stroke and orthopedic patients, than either LTCHs or HHAs. Patients who were hospitalized for a stroke in the prior acute stay constituted 14.6 percent of IRF patient stays and 2.9 percent of SNF patient stays in this sample. Within orthopedic cases, the relative percentages admitted to each setting differed by whether the case was postsurgical or medical and whether it was minor or major surgery. Neurological medical cases made up a sizable proportion of the population in HHAs (8.5 percent of their admissions) and IRFs (6.7 percent of their admissions).

LTCHs and SNFs tended to have more of the medical, rather than surgical, cases. Ventilator cases accounted for 26.3 percent of the LTCH cases but were rarely seen in the other PAC settings. Other respiratory medical conditions accounted for 9.2 percent of the LTCH admissions, 6.3 percent of the SNF admissions, and 5 percent of the HHA admissions. COPD cases accounted for 2.3 percent of the cases in this sample, with higher proportions in HHAs (3.0 percent) and LTCHs (3.8 percent), compared with SNFs (2.2 percent) and IRFs (1.0 percent).

Certain comorbidities were common across settings **(Table 8-4).** The diabetes group was the most frequently occurring comorbidity overall, although in some settings it was second most common. Respiratory diseases, including pneumonia, were also a common comorbidity present in 50.1 percent of the LTCH cases, 24.2 percent of the IRF cases, 18.2 percent of the SNF cases, and 15.0 percent of the HHA cases. History of stroke (i.e., not new onset) was also a common comorbidity in this sample, ranging from 19.7 percent of the IRF cases to 3.3 percent of the HHA cases.

Major Treatments by Setting. The use of major treatments during the first 2 days of admission, such as hemodialysis and ventilators, were not common in the PAC settings (**Table 8-5**). LTCHs had substantially higher proportions of patients receiving these treatments

(9.8 percent and 21.9 percent, respectively) than the other settings, which had less than 3 percent of these cases receiving these treatments.

Skin Conditions by Setting. More severe pressure ulcers at admission, such as stage 3 or stage 4 ulcers or stage 2 ulcers that had been present for more than 1 month, were more common among the LTCH admissions than in other settings (18.9 percent compared with 2.8 to 3.5 percent, respectively). LTCH cases were also more likely to have at least one turning surface not intact (37.3 percent), although IRF cases also had higher shares of these problems (29.1 percent).

Cognitive Status by Setting. Cognitive impairments varied by setting (**Table 8-6**). LTCHs had the highest proportion of cases that were severely impaired at admission (15.5 percent plus another 19.5 percent who could not be interviewed for various reasons), followed by SNFs (15.0 percent and only 1.5 percent missing interviews). The cognitive status of patients was based on an interview, and some patients could not be interviewed, including patients who were comatose, patients on a ventilator, and patients who had communication disorders (i.e., aphasia). The latter group may have had only communication, not cognitive impairments and were therefore, excluded from these measures.

Impairments by Setting. The frequency of the various types of impairments varied by setting. Use of indwelling or external bladder devices or intermittent catheterization at admission was found in all settings but most common in the LTCH cases, as was the need for assistance with bowel management **(Table 8-7**). Swallowing problems, such as coughing, choking, holding food, or loss of liquids, was most common in the IRF cases (9.9 percent) but also common in the other settings to a lesser extent. These impairments are often common among patients who have experienced a stroke, which also accounted for a large share of the IRF admissions. LTCHs had the largest share of cases that could not sit for 15 minutes either with or without support (23.2 percent).

Functional Status at Admission. The functional status of patients at the time of the post acute care admission varied by setting. In the overall sample, HHA patients were the most independent with the highest mean self-care (59.6) and mobility (59.9) measure, and LTCH patients were the least independent with a mean self-care measure of 33.9 and a mean mobility measure of 33.5. (**Table 8-8** and **Table 8-9**). SNF patients were slightly more independent than IRF patients. The same pattern was observed for patients with musculoskeletal conditions and nervous system conditions.

8.5 Self-Care Change and Mobility Change Descriptive Statistics

8.5.1 Functional Change

Tables 8-8 and **8-9** also show the distribution of the two function change outcomes by provider type. Please note that these are not adjusted to account for patient characteristics. The first column shows the mean function score at admission, for the overall sample and for the musculoskeletal and nervous system subpopulations (defined by the diagnosis on the prior acute discharge claim, or from the PAC CARE assessment for patients with no prior acute stay). The second column shows the mean change in function from admission to discharge, and the third column the standard deviation of the mean change score. The last five columns show the 5th, 25th, 50th, 75th, and 95th percentiles of the function change.

Self-care function at admission. Across the whole sample and the condition-specific samples, HHAs had the highest mean self-care measures at admission (overall: 59.9, musculoskeletal: 58.5, nervous system: 55.5), and LTCHs had the lowest (overall: 33.9, musculoskeletal: 41.8, nervous system: 33.1) suggesting the HHA patients were the least impaired in self-care on average and LTCH admissions were the most impaired on average (**Table 8-8**). Cases admitted to IRFs were slightly more impaired than those admitted to SNFs (43.6 compared to 45.4 at admission, respectively in the overall groups) although there were substantial areas of overlap. This was true in both the musculoskeletal and nervous system subpopulations also.

Change in self-care function. The mean self-care change for all patients was 12.4 with the 5^{th} percentile at -5.5 and the 95^{th} percentile at 37.3. IRF patients had the greatest self-care change overall (15.5 units) and within each of the subpopulations (17.4 units in the musculoskeletal and 13.8 units in the nervous system patients). SNF patients achieved the second highest unadjusted change scores in the overall patients (12.4 units improvement) and in the musculoskeletal patients (15.5 units improvement). In the nervous system populations, LTCHs and SNFs achieved very similar unadjusted results (10.4 and 10.1 units improvement, respectively). HHAs, which provide the lowest intensity of therapy services per admission, tended to achieve slightly lower unadjusted improvements in self-care in the nervous system groups. Adjusted results are presented below.

Mobility function at admission. **Table 8-9** shows the unadjusted mean admission and change in mobility measures in our sample by provider type. Distributions of the mean starting mobility measures are similar to those seen in **Table 8-7** for self-care. Across the whole sample and the condition-specific samples, HHAs had the highest mean starting mobility measures (overall: 59.9, musculoskeletal: 57.3, nervous system: 54.0), and LTCHs had the lowest (overall: 33.5, musculoskeletal: 37.0, nervous system: 33.7) suggesting, on average, the least impaired patients were admitted to HH and the most impaired to LTCHs.

Change in mobility function. The mean mobility change for all patients was 14.6 with the 5^{th} percentile at -5.3 and the 95^{th} percentile at 41.0. IRFs and SNFs had the greatest change in mobility scores over all patients (16.7 units and 16.6 units, respectively) and in musculoskeletal patients (19.4 and 20.7 units, respectively). Among the more complex nervous system disorder patients, those treated in IRFs achieved 14.8 units improvement while those treated in SNFs achieved 12.6 units and LTCH patients improved 11.2 units, followed by HH patients with 10.4 units change. But these results are not adjusted for variation in patient characteristics. They reflect the types of cases and intensity of services provided in each setting.

8.6 Multivariate Models of Factors Associated with Functional Change

Regression models were used to control for patient differences and examine the functional outcomes of patients treated in HHAs, IRFs, and LTCHs compared with patients treated in SNFs. Separate models were calculated for the two sets of functional assessment items: change in self-care measures between admission and discharge ("self-care measure change") and change in mobility measures between admission and discharge ("mobility measure change"). A higher measure in self-care and mobility indicates more independence with self-care and mobility skills. **Tables 8-10** and **8-11** provide the regression coefficients, standard errors, t-value, and p-values for each variable, including provider type and each covariate.

In reviewing the results presented in this section, it is important to keep in mind several caveats. First, it is important to note that the CARE functional assessment measures (self-care and mobility measures) are new, and the thresholds for defining differences that are clinically meaningful have not been established. While past work on the FIM™ items has considered "burden of care" associated with different FIM™ s categories, no recent work has been done in this area nor has similar work ever been done for the function items in the MDS or OASIS instruments making it difficult to interpret the clinical meaningfulness of different function change scores.

Second, in interpreting the results, it is important to recognize that this is an observational study, and thus the study design identifies associations but is not suited for causal attribution as in a randomized control trial. While our models controlled for many covariates, there are likely unobserved differences in severity or rehabilitation potential among patients treated in the different types of settings that we have not measured. For example, as part of their intake process, IRFs must evaluate and select patients who can tolerate and benefit from 3 hours a day of therapy at admission. This selection determination may include subjective factors that are not measured in the CARE assessment tool such as patient engagement. Similar considerations such as family engagement may be taken into account when considering home health admissions. Other factors that are not included in the model include time related factors such as the time since the last hospitalization and the length of time between the admission and discharge assessment of function.

The results are preliminary, and additional work is needed to define clinically meaningful differences in self-care and mobility functional status. Finally, we recognize that these are PAC discharge outcomes and that longer-term functional outcomes are also important but not examined here.

Three sets of regressions are reported; each set predicts the change in self-care measure and the change in mobility measure for three populations. The first set reports on the results of the two regression models for all patients in the analytic sample, and the next two sets report the models for subgroups of patients: musculoskeletal patients and patients with nervous system disorders. These two subgroups were selected because they are treated in multiple PAC settings but the types and levels of impairment typically associated with these conditions may differ by setting. This analysis takes into account that for different patient conditions, some variables, such as cognitive status or certain comorbidities, might be more or less important in determining a patient's functional change from admission to discharge. As stated in previous sections, patients' primary conditions were identified using the diagnoses found on the prior acute discharge claim. The target groupings of conditions described below were defined according to major diagnostic category (MDCs). The nervous system conditions (MDC 1) include the following primary diagnosis categories: neurologic, stroke; neurologic, medical; and neurologic, surgical. The IRFs in our sample had the largest proportion of nervous system patients in our data. Stroke made up approximately 45 percent of the total of the nervous system categories in the sample population (see **Table 8-2** for more details). The musculoskeletal conditions (MDC 8) include the following orthopedic primary diagnosis categories: minor surgical, major surgical, spinal, minor medical, and major medical diagnoses (See Section 5, **Table 5-1** for more information). Results from the overall and condition-specific regression analyses are discussed below.

8.6.1 Multivariate Models of Self-Care Change

Three sets of models are presented below. The first presents results for all conditions receiving therapy services in these PAC settings. The second model presents results for a subset of cases: those with musculoskeletal conditions. The third model presents results for a different subset of cases: those with nervous system conditions.

Overall Conditions. **Table 8-10** presents the results for the model predicting change in the self-care measure for patients across all conditions. Overall, this model explained 22 percent of the variance in self-care change, and the mean change in the self-care measure for all patients was 12.4. After controlling for patient factors in the model, no statistically significant differences in outcomes were observed for LTCH patients compared with SNF patients. However, statistically significant differences in outcomes were seen for HHA and IRF patients relative to SNF patients. HHA patients had a mean change that was 4.02 units higher ($p = 0.001$) than that of SNF patients, and IRF patients had a mean change measure that was 3.75 units higher ($p = 0.02$) than that of SNF patients. The additional 4.02 and 3.75 self-care units achieved by HHA and IRF patients represent a 32.4 percent and 30.2 percent improvement in self-care for these patients relative to the mean increase of 12.4 units for SNF patients, respectively (HHA: 4.02/12.4 = 32.4 percent; IRF: 3.75/12.4 = 30.2 percent). As suggested in Section 5, one way of thinking about this difference would be to consider at a patient having a self-care admission raw score of 29 (Rasch score 46.4 on average) based on the sum of the eight 6-point self-care items and moving to a discharge score of 33 (Rasch score of 50.2, roughly a 3.8 unit change).[10] This could occur, for example, by moving from level 2 (helper does more than 50 percent of effort) to level 4 (requiring supervision or steadying assistance) on two of the self-care activities, a level of change which seems substantial.

Several covariates were significant in predicting self-care change. Younger-elderly (65-84 years) populations had significantly greater change in self-care measures than those 85 years of age or over, and Blacks had less improvement than other populations.

Other conditions that appear to be associated with greater self-care improvement include those with no immediately prior hospitalization, those with surgeries in the prior hospitalization, including respiratory, cardiac, orthopedic, transplant and gastrointestinal (GI) cases. Comorbidities, in general, tended to be associated with lower changes in self-care than populations without comorbidities. Having certain major treatments at admission also affected change in self-care measures: hemodialysis was significantly associated with lower change measures as was the presence of a severe pressure ulcer (stage 3 or stage 4 or stage 2 that is older

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[10] As noted in the Section 5 discussion of the raw score to Rasch measure transformations, the raw score self-care change scores ranged from 8 to 48 so this appears to be a relatively large change in self-care status (See Table 5-4).

than 1 month). Cognitive impairment was negatively related to self-care improvement as was prior dependency in self-care and the presence of most impairments at admission. Sitting endurance and depression were also negatively related to self-care improvement. Self-care scores at admission was also negatively related to change in self-care. This finding is consistent with other research showing that greater independence (a higher measure) at admission is associated with less change.

Musculoskeletal Conditions. It is important to look at models of functional change within the orthopedic population, because these patients receive a significant amount of physical therapy and/or occupational therapy and may be seen in more than one type of provider. Important subgroups within this population are patients who have elective hip or knee replacements and patients who are recovering from a hip fracture. This sample included 3,492 cases with musculoskeletal conditions as a primary diagnosis.

The mean change in self-care measure for all patients with musculoskeletal conditions was 15.9 units which as noted above, and shown in **Table 5-4**, is a substantial change score. However, after controlling for other patient characteristics in the regression model, IRF and LTCH patients were not statistically significantly different from SNF patients in their self-care improvements in this population. HHA patients with musculoskeletal conditions did have statistically significantly higher change in self-care measures (4.35 units; $p = 0.02$) than those treated in SNFs **(Table 8-11)**. The increase of 4.35 units attributable to HHA patients after controlling for patient acuity represents an increase of 28.1 percent relative to the overall change for SNF patients (4.35/15.5 = 28.1 percent). As previously noted, the clinical meaningfulness of this difference has not yet been established but the conversion table in Section 5 suggests these differences are potentially clinically meaningful.

This model, which included both patient acuity and setting indicators, explained 19 percent of the variance in self-care improvement in the musculoskeletal population. Key covariates associated with changes in self-care were similar to those in the overall conditions group with a few exceptions—younger elderly populations still showed greater change than those 85 years of age or over. Race is no longer significant but admission from a long-term nursing facility is associated with less change in self-care. Similar but fewer types of medical conditions and comorbidities were significant in the musculoskeletal population. Hemodialysis had a greater effect on reducing self-care change in this group: those receiving hemodialysis treatments had change scores that were 4.35 lower than those not on hemodialysis whereas hemodialysis in the overall population was associated with a 2.19 unit lower score. Severe pressure ulcers had similar effects as in the overall but severe cognitive impairment had twice as great a negative effect in self-care change for the musculoskeletal impaired populations. The other significant covariates in predicting self-care change in the musculoskeletal population were similar to the overall population noted above.

Nervous System Conditions. The second condition group targeted for separate examination were patients with nervous system conditions (n = 1,756). Nervous system patients included patients who were in the period immediately following a stroke as well as those having other nervous system conditions. The stroke population is of interest in functional outcome models, because they are a population that receives a significant amount of all types of therapy and are commonly seen by a wide variety of providers, including speech and language pathologists, occupational therapists, physical therapists, and others, and who often have varying levels of severity in impairments.

The mean change in self-care measures for patients with nervous system disorders was 12.0 units. In the self-care regression model, patients who received IRF services had statistically significantly greater change in self-care status than patients treated in SNFs, even after controlling for patient covariates **(Table 8-12)**. Patients receiving IRF care achieved a mean change in self-care measure that was 3.93 units higher ($p = 0.02$) than the change for patients treated in SNFs. The additional 3.93 units achieved by IRF patients represents a 38.9 percent improvement in self-care relative to the mean increase of SNF patients. Although significant in the all patient model, HHA settings was not associated with a statistically significant change in self-care in nervous system patients, although the results suggest that the change is indicative that with a larger sample the results may have been significant ($p=0.10$).

This model explained 17 percent of the variance, slightly less than the other two models suggesting that additional, unobserved, factors may be important for explaining self-care in the nervous system populations than for the musculoskeletal populations. Again, the key variables associated with change in self-care were similar to the other models. For this group, however, race is again important: Black patients have self-care change scores that are 2.54 units lower than other patients. Medicaid as a secondary payer is also significant in this group and admission from a nursing facility is associated with almost a 10 unit lower change score than patients admitted from other settings. Fewer medical conditions and comorbidities were significant in this population than in the other two groups but comorbidities of polyneuropathy, seizures, and other neurological disorders were associated with 1.7 unit lower change score. Ventilator use was statistically significant in this group with 6.7 units greater change in self-care for patients on ventilators. Again, severe pressure ulcers, cognitive impairment, functional levels prior to the current illness, exacerbation or injury and bladder and bowel impairments were all negatively associated with self-care changes. As in the other two groups, self expression was positively associated with self-care changes, and sitting endurance and self-care at admission were negatively related to self-care improvements.

8.6.2 Multivariate Models of Mobility Change

The unadjusted mean change in the mobility measure for all patients was 14.6 units. As shown in Section 5, this change would be associated with moving from a raw summed mobility score of 45 (Rasch mobility score of 45.05) to a raw summed mobility score of 74 on average (Rasch mobility score of 59.37). This represents improving approximately 26 units across the 13 mobility measures, an apparently substantial change in function. The multivariate model including both patient acuity measures and settings for the overall population explained 22 percent of the variance in the changes in mobility **(Table 8-13).** After controlling for the patient covariates, only the HH indicator was statistically significantly different in the mean change measures than the SNF patients; the change scores for IRFs and LTCHs were not statistically significantly different than those for SNFs in the aggregate. HHA patient had a mean change that was 2.52 units higher ($p < 0.10$) than that of SNF patients. While this is slightly higher than the traditional 0.05 cut off for determining statistical significance, the HHA result is noted because the results suggest that if the sample size were larger, these results may be significant. The additional 2.52 mobility units achieved by HHA patients represent an increase of 15.2 percent for these patients relative to the mean increase of SNF patients.

For the overall population, the factors that predicted changes in mobility were similar to those predicting changes in self-care. Mobility was associated with slightly different medical conditions: neurological medical cases had 1.47 lower mobility scores at discharge, more medical primary conditions were associated with significant changes in mobility (integumentary, kidney and urinary, septicemia, hematologic to name a few. The comorbidities affecting mobility change were similar to those affecting self-care with the addition of liver and other GI conditions being associated with slightly greater mobility, ischemic HD/vascular comorbidities were associated with lower mobility, as were UTI comorbidities relative to self-care change. Severe pressure ulcers had significant effects resulting in 4 units lower mobility scores at discharge than those patients without severe pressure ulcers, after controlling for the other acuity measures in the model. Impairments also had similar effects on mobility scores as they had on changes in self-care scores in the overall population.

The next section focuses on examining mobility outcome change models in clinically defined subpopulations of interest: musculoskeletal and nervous system conditions. The mean change in mobility measure for all musculoskeletal patients was 19.0., again a substantial change in mobility associated with treatment. However, the HHA, IRF and LTCH patients had mean mobility measure changes that were not statistically significantly different than those for patients treated in SNFs **(Table 8-14).** This contrasts to the findings in the all patient model where the HHA findings were somewhat significant. This model explained 19 percent of the variance. Key covariates associated with less improvement in the mobility measure were 85 years of age or over, primary condition medical/nonsurgical, comorbidities, presence of a pressure ulcer, hemodialysis, severe cognitive impairment, prior functional dependence, signs and symptoms of a swallowing problem, no intake by mouth (NPO) status, severe vision impairment, sitting endurance limitations, mood disorder symptoms, and lower admission mobility measure. Similar to the self-care models, race was no longer significant in this subgroup. Prior service use in the last 2 months was significantly associated with less improvement, but only for prior HH use, not short stay hospitalizations. Depression also becomes a significant negative covariate for mobility change in this group, in contrast to the neurological or “all patient” groups, for whom depression was not a significant predictor after controlling for the other factors in the model.

The mean change in mobility measures for patients with nervous system disorders was 13.4 units. In the regression model for change in mobility status, patients who received HHA, IRF and LTCH services had mobility change measures that were not statistically significantly different from changes for patients treated in SNFs **(Table 8-15)**. For the mobility model, 16 percent of the variance was explained. The key covariates associated with less improvement in mobility were age greater than 85 years, admission directly from a nursing facility, severe pressure ulcer, difficulty with expression, sitting endurance limitations, and admission mobility measure. Being admitted directly from a long-term care facility is significant, as is admission from a short stay hospital. As in the all patient model, there were no significant differences across the neurological subgroups.

8.7 Discussion of Functional Change Findings

In summary, across all patients, patients' self-care measure increased an average of 12.4 units during the PAC admission, and their mobility measure increased an average of 14.6 units. While the clinical implications of this change have yet to be established, in terms of raw score equivalents, these changes are substantial. Mean change in self-care and mobility varied for the two diagnosis groups we examined: greater change in the musculoskeletal (15.9 and 19.0 units respectively) and roughly equivalent rates of change in populations with nervous system conditions (12 and 13.4 units). The factors affecting self-care and mobility were similar within population groups underscoring the potential value of condition-specific models when considering the factors associated with changes in function.

We observed that HHA patients and IRF patients, when compared with SNF patients, had statistically significantly greater improvements in the self-care measures by discharge for all patients after controlling for patient acuity measures at admission. The LTCH setting was not associated with a significant impact on self-care change. For patients with musculoskeletal conditions, HHA patients, had greater improvements in self-care measures than SNF patients, but there were no significant differences between SNFs and the other settings. For patients with musculoskeletal conditions, IRF patients had statistically significantly greater improvements in the self-care measures by discharge than SNF patients, but again, the other settings were not significantly different than SNFs in their outcomes.

Mobility change showed less variation by provider type after controlling for patient characteristics than the self-care models. After controlling for acuity at admission, HHAs were associated with significantly higher gains in mobility than the SNF referent group. These results were only marginally statistically significant but they suggest that stronger results may be found with larger samples. No other setting-specific differences were found for the overall population. For patients with musculoskeletal conditions and patients with nervous system disorders, no differences in mobility recovery were found between either IRFs or HHAs when compared with SNFs, after controlling for patient characteristics.

In reviewing the results presented in this chapter, it is important to keep in mind several caveats. First, it is important to note that the CARE functional assessment measures (self-care and mobility measures) are new, and the thresholds for defining differences that are clinically meaningful have not been established. It is difficult to assess the clinical implications of these statistical differences, particularly at the level of the individual patient. These models, containing both setting indicators and patient acuity measures, explained 16 to 22 percent of the variation in change in self-care and mobility, confirming that patient case-mix factors at admission are important predictors of functional change. The PAC provider setting was associated with self-care functional change for persons with particular types of primary diagnoses, suggesting that the choice among type of provider based on patient characteristics and patient needs may be important in addition to the clinical interventions performed within the setting. Previous research (Mallinson et al., 2011) examining discharge functional status for patients recovering after a hip replacement found that setting type and covariates explained 48 percent of discharge self-care variance and 36 percent of discharge mobility variance.[11]

As noted in the literature review, many factors influence how much functional improvement patients achieve in PAC settings. We presented results overall and by two primary diagnosis groups (e.g., musculoskeletal, nervous system), because diagnosis is a key factor that influences functional outcomes. We recognize, however, that within a diagnosis group, outcomes are affected by interactions of key factors such as admission self-care abilities, the ability to remember and learn, and the availability of a caregiver.

Second, in interpreting the results, it is important to recognize that this is an observational study, and thus the study design identifies associations but is not suited for causal attribution as in a randomized control trial. As noted above, this study is useful for identifying associations, but the results are preliminary. Future analysis with a much larger sample of patients is needed to examine how these factors interact and affect functional outcomes. In addition, work to examine clinically meaningful differences in self-care and mobility functional status is needed. These issues are difficult given that the meaningfulness of a particular functional change likely depends on individual patients' goals, the particular activities in which the improvement occurred, and the values and desires of the people with disabilities and their families and friends who care about them. This work is important in providing uniformly measured patient attributes across setting and for beginning to understand the relative severity of patients admitted to different PAC settings.

While our models controlled for many covariates, there are likely unobserved differences in severity or rehabilitation potential among patients treated in the different types of settings that we have not measured. The models control for many but not all factors at admission to the PAC settings. Numerous unmeasured factors can very systematically between settings and also be associated with functional change. Important unmeasured factors include treatment objectives, patient engagement in therapy, patient motivation, and the extent of caregiver involvement. The four settings vary in the extent to which their patients are admitted with a major treatment objective related to functional improvement. This may be particularly pertinent when interpreting the all-patient models. Another factor not included in the model is the length of time from admission to discharge within the setting of care. As noted above, the average length of stay varied by setting: HHA stays tended to be longest (52 percent of all cases were longer than 30 days) while the shortest stay cases were in IRFs (over 63 percent were shorter than 14 days), followed by SNFs (41 percent were shorter than 14 days).

The results are preliminary, and additional work is needed to define clinically meaningful differences in self-care and mobility functional status. Finally, we recognize that these are PAC discharge outcomes and that longer-term functional outcomes are also important but not examined here. In interpreting the significance of settings indicators, it is important to remember that the effectiveness of specific interventions is not be assessed in any manner.

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[11] This study included length of stay in its model, which increases explanatory power but was not appropriate for payment models and was omitted from our work.

Table 8-1
Beneficiary length of stay, functional outcomes sample, overall and by provider type

Length of stay	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Length of stay not calculated	13	0.1	†	†	†	†	†	†	†	†
Length of stay 7 days or fewer	1,690	14.0	175	5.5	890	21.4	111	5.6	514	18.7
Length of stay between 8-14 days	3,096	25.7	353	11.1	1,865	44.9	251	12.8	627	22.8
Length of stay between 15-30 days	4,081	33.8	986	30.9	1,256	30.2	945	48.0	894	32.5
Length of stay between 31-60 days	2,324	19.3	1,194	37.4	122	2.9	508	25.8	500	18.2
Length of stay greater than 61 days	861	7.1	479	15.0	17	0.4	151	7.7	214	7.8
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0

† Indicates sample size of less than 11.

NOTE: HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

SOURCE: RTI analysis of Phase 1 CARE assessments (care_cs375).

Table 8-2
Administrative items and admission information, functional outcomes sample, overall and by provider type

Variable	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Age										
64 years and under	1,421	11.8	323	10.1	489	11.8	437	22.2	172	6.3
65-74 years	3,212	26.6	766	24.0	1,275	30.7	613	31.1	558	20.3
75-84 years	4,533	37.6	1,205	37.8	1,588	38.2	652	33.1	1,088	39.6
85 and above	2,897	24.0	895	28.1	806	19.4	266	13.5	930	33.8
Total	12,063	100.0	3,189	100.0	4,158	100.0	1,968	100.0	2,748	100.0
Missing	†	†	†	†	†	†	†	†	†	†
Gender										
Male	4,620	38.3	1,117	35.0	1,750	42.1	922	46.9	831	30.2
Female	7,445	61.7	2,073	65.0	2,408	57.9	1,046	53.2	1,918	69.8
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0
Race/ethnicity										
American Indian or Alaska Native	43	0.4	†	†	†	†	14	0.7	17	0.6
Asian	127	1.1	34	1.1	39	0.9	30	1.5	24	0.9
Black or African American	930	7.7	267	8.4	340	8.2	205	10.4	118	4.3
Hispanic or Latino	267	2.2	84	2.6	73	1.8	65	3.3	45	1.6
Native Hawaiian or Pacific Islander	20	0.2	†	†	†	†	†	†	†	†
White	10,582	87.7	2,783	87.2	3,646	87.7	1,623	82.5	2,530	92.0
Unknown	106	0.9	15	0.5	53	1.3	28	1.4	†	†
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0
Medicaid as secondary payer (FFS or HMO)										
Yes	860	7.1	118	3.7	317	7.6	332	16.9	93	3.4
No	11,205	92.9	3,072	96.3	3,841	92.4	1,636	83.1	2,656	96.6
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0

(continued)

Table 8-2 (continued)
Administrative items and admission information, functional outcomes sample, overall and by provider type

Variable	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Admitted from immediately prior to CARE stay										
Community residential setting	1,177	9.8	924	29.0	167	4.0	49	2.5	37	1.3
Nursing facility	70	0.6	54	1.7	†	†	†	†	†	†
SNF/TCU	712	5.9	579	18.2	54	1.3	42	2.1	37	1.3
Hospital emergency department	93	0.8	45	1.4	25	0.6	†	†	17	0.6
Short-stay acute hospital	9,422	78.1	1,190	37.3	3,831	92.1	1,828	92.9	2,573	93.6
LTCH	147	1.2	46	1.4	57	1.4	15	0.8	29	1.1
IRF	330	2.7	292	9.2	†	†	†	†	24	0.9
Psychiatric hospital or unit	23	0.2	†	†	†	†	†	†	15	0.5
Other	91	0.8	52	1.6	14	0.3	14	0.7	†	†
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0
Any service use in the last 2 months[1]										
LTCH	384	3.2	91	2.9	76	1.8	164	8.3	53	1.9
Home health or outpatient services	1,795	14.9	505	15.8	667	16.0	374	19.0	249	9.1
SNF	1,563	13.0	713	22.4	176	4.2	334	17.0	340	12.4
IRF	603	5.0	348	10.9	159	3.8	45	2.3	51	1.9
Short-stay acute hospital	10,433	86.5	2,135	66.9	3,834	92.2	1,825	92.7	2,639	96.0
None	616	5.1	502	15.7	89	2.1	16	0.8	†	†
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0
Prior functioning: self-care[2]										
Dependent	688	5.7	255	8.0	85	2.0	228	11.6	120	4.4
Needed partial assistance	3,071	25.5	1,015	31.8	801	19.3	516	26.2	739	26.9
Independent	8,047	66.7	1,901	59.6	3,219	77.4	1,109	56.4	1,818	66.1
Not applicable	†	†	†	†	†	†	†	†	†	†
Unknown	249	2.1	16	0.5	51	1.2	113	5.7	69	2.5
Total	12,063	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,747	99.9
Missing	†	†	†	†	†	†	†	†	†	†

(continued)

Table 8-2 (continued)
Administrative items and admission information, functional outcomes sample, overall and by provider type

Variable	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Prior functioning: mobility (ambulation)										
Dependent	486	4.0	151	4.7	72	1.7	185	9.4	78	2.8
Needed partial assistance	2,222	18.4	751	23.5	560	13.5	446	22.7	465	16.9
Independent	8,688	72.0	2,154	67.5	3,387	81.5	1,107	56.3	2,040	74.2
Not applicable	395	3.3	117	3.7	77	1.9	113	5.7	88	3.2
Unknown	272	2.3	17	0.5	62	1.5	117	5.9	76	2.8
Total	12,063	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,747	99.9
Missing	†	†	†	†	†	†	†	†	†	†
Prior functioning: mobility (wheelchair)										
Dependent	503	4.2	155	4.9	58	1.4	175	8.9	115	4.2
Needed partial assistance	993	8.2	198	6.2	282	6.8	247	12.6	266	9.7
Independent	1,905	15.8	386	12.1	749	18.0	239	12.1	531	19.3
Not applicable	8,055	66.8	2,402	75.3	2,847	68.5	1,122	57.0	1,684	61.3
Unknown	607	5.0	49	1.5	222	5.3	185	9.4	151	5.5
Total	12,063	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,747	99.9
Missing	†	†	†	†	†	†	†	†	†	†

† Indicates sample size of less than 11.

[1] Patients may have received services from more than one provider type in the 2 months prior to the CARE admission.

[2] Prior functioning: Clinicians reported on the patient's usual ability prior to the current illness, exacerbation, or injury. Self-care includes bathing, dressing, using the toilet, and eating. Mobility (ambulation) includes walking from room to room with or without devices such as cane, crutch, or walker. Mobility (wheelchair) includes moving from room to room using a wheelchair, scooter, or other wheeled mobility device. Patients were classified as "independent," "needed partial assistance," or "dependent" on these items. Patients were considered independent if they completed the activities by themselves, with or without an assistive device, with no assistance from a helper. Patients were considered dependent if a helper completed the activity for the patient.

NOTE: CARE = Continuity Assessment Record and Evaluation; FFS = fee-for-service; HHA = home health agency; HMO = health maintenance organization; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility; TCU = transitional care unit.

SOURCE: RTI analysis of Phase 1 CARE assessments and Medicare claims data (cru_vajm71).

Table 8-3
Medical diagnosis groupings, functional outcomes sample, overall and by provider type

Variable	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Primary medical diagnosis groups[1]										
No prior hospitalization	78	0.6	†	†	37	0.9	28	1.4	†	†
Neurologic, stroke	798	6.6	74	2.3	606	14.6	38	1.9	80	2.9
Neurologic, surgical	278	2.3	17	0.5	214	5.1	27	1.4	20	0.7
Neurologic, medical	684	5.7	271	8.5	278	6.7	22	1.1	113	4.1
Respiratory, ventilator and tracheostomy	640	5.3	14	0.4	91	2.2	517	26.3	18	0.7
Respiratory, surgical	123	1.0	32	1.0	35	0.8	33	1.7	23	0.8
Respiratory, medical	620	5.1	160	5.0	107	2.6	181	9.2	172	6.3
Respiratory, COPD	274	2.3	95	3.0	43	1.0	75	3.8	61	2.2
Cardiovascular, vascular surgical	271	2.2	43	1.3	123	3.0	65	3.3	40	1.5
Cardiovascular, cardiac surgical	508	4.2	170	5.3	174	4.2	79	4.0	85	3.1
Cardiovascular, general	286	2.4	128	4.0	47	1.1	33	1.7	78	2.8
Cardiovascular, vascular medical	86	0.7	34	1.1	21	0.5	13	0.7	18	0.7
Cardiovascular, cardiac medical	531	4.4	194	6.1	103	2.5	75	3.8	159	5.8
Orthopedic, minor surgical	860	7.1	144	4.5	402	9.7	59	3.0	255	9.3
Orthopedic, major surgical	1,518	12.6	346	10.8	577	13.9	24	1.2	571	20.8
Orthopedic, spinal	430	3.6	64	2.0	278	6.7	14	0.7	74	2.7
Orthopedic, minor medical	544	4.5	219	6.9	151	3.6	24	1.2	150	5.5
Orthopedic, major medical	158	1.3	37	1.2	64	1.5	†	†	54	2.0
Integumentary, surgical	107	0.9	24	0.8	19	0.5	52	2.6	12	0.4
Integumentary, medical	295	2.4	137	4.3	27	0.6	62	3.2	69	2.5
Endocrine, surgical	36	0.3	†	†	†	†	†	†	†	†
Endocrine, medical	252	2.1	112	3.5	49	1.2	24	1.2	67	2.4
Kidney and urinary, surgical	52	0.4	15	0.5	†	†	†	†	21	0.8
Kidney and urinary, medical	362	3.0	121	3.8	84	2.0	45	2.3	112	4.1

(continued)

Table 8-3 (continued)
Medical diagnosis groupings, functional outcomes sample, overall and by provider type

Variable	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Infections, surgical	123	1.0	17	0.5	32	0.8	60	3.0	14	0.5
Infections, medical	55	0.5	14	0.4	12	0.3	17	0.9	12	0.4
Infections, septicemia	276	2.3	49	1.5	46	1.1	110	5.6	71	2.6
Transplant	†	†	†	†	†	†	†	†	†	†
GI and hepatobiliary, minor surgical	149	1.2	41	1.3	36	0.9	25	1.3	47	1.7
GI and hepatobiliary, major surgical	208	1.7	49	1.5	41	1.0	68	3.5	50	1.8
GI and hepatobiliary, minor medical	212	1.8	67	2.1	40	1.0	30	1.5	75	2.7
GI and hepatobiliary, major medical	181	1.5	66	2.1	24	0.6	44	2.2	47	1.7
Hematologic, surgical	20	0.2	†	†	†	†	†	†	†	†
Hematologic, medical	88	0.7	39	1.2	15	0.4	12	0.6	22	0.8
Other, surgical	228	1.9	46	1.4	81	1.9	63	3.2	38	1.4
Other, medical	725	6.0	330	10.3	270	6.5	26	1.3	99	3.6
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0

† Indicates sample size of less than 11.

[1] Primary diagnosis is determined based on the Medicare Severity-Diagnosis Related Group (MS-DRG) reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the post-acute care (PAC) claim was grouped into an MS-DRG.

NOTE: COPD = chronic obstructive pulmonary disease; GI = gastrointestinal bleeding; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

SOURCE: RTI analysis of Phase 1 CARE assessments and Medicare claims data (cru_vajm71).

Table 8-4
Top comorbid condition categories, functional outcomes sample, overall and by provider type

Variable	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Comorbid condition categories[1]										
Morbid obesity (HCC22)	456	3.8	36	1.1	188	4.5	190	9.7	42	1.5
Metabolic, diabetes, other endocrine (HCC21,23,24,17,18,19,20,26)	6,205	51.4	1,027	32.2	2,422	58.2	1,550	78.8	1,206	43.9
Liver, other GI (HCC27,28,30,29,31,32,33,34,35)	4,396	36.4	529	16.6	1,918	46.1	951	48.3	998	36.3
Orthopedic infection, rheumatoid arthritis, severe skeletal, musculoskeletal, amputation (HCC39,40,41,42,43,44,45,189)	5,728	47.5	1,110	34.8	2,608	62.7	763	38.8	1,247	45.4
Psychiatric/depression (HCC54,57,58,59,60,55,56)	1,066	8.8	99	3.1	472	11.4	336	17.1	159	5.8
Head and spine injury (HCC166,167,70,71,72)	411	3.4	28	0.9	238	5.7	117	5.9	28	1.0
Polyneuropathy, seizure, other neurological (HCC75,79,73,74,76,77,78)	1,712	14.2	263	8.2	871	20.9	341	17.3	237	8.6
Shock, ischemic HD, vascular (HCC84,86,87,106,107,108)	1,833	15.2	207	6.5	698	16.8	643	32.7	285	10.4
Stroke (HCC99,100,101,102,103,104)	1,266	10.5	104	3.3	819	19.7	167	8.5	176	6.4
Pneumonia, pleural effusion, other respiratory (HCC114,115,116,117,110,111,112)	2,971	24.6	478	15.0	1,007	24.2	985	50.1	501	18.2
Acute and chronic renal (HCC135,136,137,138)	1,082	9.0	115	3.6	416	10.0	425	21.6	126	4.6
Cellulitis (HCC120,164)	427	3.5	44	1.4	146	3.5	182	9.2	55	2.0
UTI (HCC141,144)	1,994	16.5	104	3.3	1,101	26.5	511	26.0	278	10.1
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0

[1] Comorbidities are based on the diagnoses listed on the CARE admission assessment.

NOTE: HCC = hierarchical condition categories; HD = heart disease; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility; UTI = urinary tract infection.

SOURCE: RTI analysis of Phase 1 CARE assessments (cru_vajm71).

Table 8-5
Current medical information, functional outcomes sample, overall and by provider type

Variable	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Major treatments										
Hemodialysis	373	3.1	43	1.3	86	2.1	193	9.8	51	1.9
Ventilator (weaning and non-weaning)	444	3.7	†	†	†	†	431	21.9	†	†
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0
Severe pressure ulcer present[1]										
Yes	674	5.6	88	2.8	118	2.8	371	18.9	97	3.5
No	11,391	94.4	3,102	97.2	4,040	97.2	1,597	81.1	2,652	96.5
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0
Turning surfaces—at least one not intact										
Yes	2,716	22.5	233	7.3	1,211	29.1	735	37.3	537	19.5
No	9,349	77.5	2,957	92.7	2,947	70.9	1,233	62.7	2,212	80.5
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0

† Indicates sample size of less than 11.

[1] Severe pressure ulcers are defined as presence of any stage 3, 4, or unstageable pressure ulcer, or a stage 2 pressure ulcer that has been present for more than 2 months.

NOTE: HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

SOURCE: RTI analysis of Phase 1 CARE assessments (cru_vajm71).

Table 8-6
Cognitive status, functional outcomes sample, overall and by provider type

Variable	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Cognitive status (BIMS with observational assessment)[1]										
Cognitive abilities intact or borderline	7,411	61.4	2,153	67.5	2,503	60.2	948	48.2	1,807	65.7
Cognitive abilities moderately impaired	2,337	19.4	593	18.6	925	22.2	331	16.8	488	17.8
Cognitive abilities severely impaired	1,557	12.9	356	11.2	482	11.6	306	15.5	413	15.0
No interview, comatose, missing, or unresponsive/ minimally conscious, communication disorder	760	6.3	88	2.8	248	6.0	383	19.5	41	1.5
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0
Depression present[2]										
Yes	1,126	9.3	293	9.2	471	11.3	162	8.2	200	7.3
No	8,152	67.6	2,424	76.0	2,569	61.8	953	48.4	2,206	80.2
No interview, comatose, or missing	2,787	23.1	473	14.8	1,118	26.9	853	43.3	343	12.5
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0
Depression (feeling sad)										
Never	3,790	31.4	1,100	34.5	1,217	29.3	332	16.9	1,141	41.5
Rarely	2,036	16.9	695	21.8	676	16.3	175	8.9	490	17.8
Sometimes	2,548	21.1	689	21.6	814	19.6	454	23.1	591	21.5
Often	714	5.9	207	6.5	249	6.0	119	6.0	139	5.1
Always	224	1.9	34	1.1	99	2.4	47	2.4	44	1.6
Unable to respond	217	1.8	27	0.8	60	1.4	50	2.5	80	2.9
Comatose, missing or no interview	2,536	21.0	438	13.7	1,043	25.1	791	40.2	264	9.6
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0

[1] Patients are considered to be severely cognitively impaired if they received a score of less than 8 on the Brief Interview for Mental Status (BIMS). Patients who did not receive an interview and who were only able to recall one item, or who could recall only two but could not recall that they were "in a hospital, nursing home, or home" on the observational assessment of cognitive status were also considered to be severely cognitively impaired. Patients who scored from 8 to 12 on the BIMS or who could recall two items on the observational assessment including that they were "in a hospital, nursing home, or home" were considered moderately impaired.

[2] Patients were considered depressed if they reported being sad "often" or "always" in the 2 weeks prior to the assessment interview. Patients who were unable to respond were grouped with the "comatose, no interview or missing" category.

NOTE: BIMS = Brief Interview for Mental Status; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

SOURCE: RTI analysis of Phase 1 CARE assessments (cru_vajm71).

Table 8-7
Impairments section, functional outcomes sample, overall and by provider type

Variable	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Bladder: indwelling or external device used										
Yes	2,886	23.9	153	4.8	1,275	30.7	1,157	58.8	301	10.9
No	9,179	76.1	3,037	95.2	2,883	69.3	811	41.2	2,448	89.1
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0
Bowel: assistance needed with device										
Yes	4,498	37.3	371	11.6	1,803	43.4	1,408	71.5	916	33.3
No	7,567	62.7	2,819	88.4	2,355	56.6	560	28.5	1,833	66.7
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0
Swallowing: signs and symptoms of disorder present[1]										
Yes	770	6.4	112	3.5	413	9.9	123	6.3	122	4.4
No	11,295	93.6	3,078	96.5	3,745	90.1	1,845	93.8	2,627	95.6
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0
Swallowing: NPO—intake not by mouth										
Yes	847	7.0	14	0.4	131	3.2	662	33.6	40	1.5
No	11,217	93.0	3,176	99.6	4,027	96.8	1,305	66.3	2,709	98.5
Total	12,064	100.0	3,190	100.0	4,158	100.0	1,967	99.9	2,749	100.0
Missing	†	†	†	†	†	†	†	†	†	†
Expression of ideas and wants										
Rarely/never	375	3.1	46	1.4	140	3.4	152	7.7	37	1.3
Frequently	768	6.4	140	4.4	312	7.5	151	7.7	165	6.0
Difficulty	2,155	17.9	599	18.8	844	20.3	354	18.0	358	13.0
Without difficulty	8,482	70.3	2,392	75.0	2,832	68.1	1,083	55.0	2,175	79.1
Unknown	285	2.4	13	0.4	30	0.7	228	11.6	14	0.5
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0

(continued)

Table 8-7 (continued)
Impairments section, functional outcomes sample, overall and by provider type

Variable	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Ability to see in adequate light										
Severely impaired	245	2.0	68	2.1	72	1.7	56	2.8	49	1.8
Not severely impaired	11,309	93.7	3,100	97.2	3,965	95.4	1,573	79.9	2,671	97.2
Unable to assess, unknown, missing	511	4.2	22	0.7	121	2.9	339	17.2	29	1.1
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0
Ability to hear										
Severely impaired	167	1.4	58	1.8	44	1.1	34	1.7	31	1.1
Not severely impaired	11,580	96.0	3,127	98.0	4,062	97.7	1,693	86.0	2,698	98.1
Unable to assess, unknown, missing	318	2.6	†	†	52	1.3	241	12.2	20	0.7
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0
Respiratory status[2]										
Impaired	2,510	20.8	678	21.3	783	18.8	591	30.0	458	16.7
Not impaired	8,925	74.0	2,500	78.4	3,319	79.8	851	43.2	2,255	82.0
Not assessed/not applicable	183	1.5	†	†	54	1.3	94	4.8	26	0.9
Ventilator (weaning and non-weaning)	444	3.7	†	†	†	†	431	21.9	†	†
Missing	†	†	†	†	†	†	†	†	†	†
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0
Sitting endurance[3]										
No, could not do	841	7.0	77	2.4	185	4.4	456	23.2	123	4.5
Yes, can do with support	4,987	41.3	1,300	40.8	1,966	47.3	668	33.9	1,053	38.3
Yes, can do without support	5,707	47.3	1,777	55.7	1,923	46.2	498	25.3	1,509	54.9
Not assessed due to medical restriction	530	4.4	36	1.1	84	2.0	346	17.6	64	2.3
Total	12,065	100.0	3,190	100.0	4,158	100.0	1,968	100.0	2,749	100.0

† Indicates sample size of less than 11.

[1] Patients are considered to have symptoms of a possible swallowing disorder if the assessment was marked as “Coughing or choking during meals or when swallowing medications,” “Holding food in mouth/cheeks or residual food in mouth after meals,” or “Loss of liquids/solids from mouth when eating or drinking.”

[2] Patients are considered to have impaired respiratory status where respiratory status was evaluated while the patient was using supplemental oxygen, and, for patients where status was only reported for activity without supplemental oxygen, if the patient was dyspneic or noticeably short of breath with minimal or less exertion. Patients on ventilators are included in a separate category.

[3] Patients were evaluated on their ability to tolerate sitting for 15 minutes to determine sitting endurance.

NOTE: HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; NPO = no intake by mouth; SNF = skilled nursing facility.

SOURCE: RTI analysis of Phase 1 CARE assessments (cru_vajm71).

Table 8-8
Self-care: Descriptive information on self-care functional change, by facility type

Setting	Mean admission score	Mean change	Standard deviation of mean change	5th %tile	25th %tile	50th %tile	75th %tile	95th %tile
Overall								
Overall (n = 12,065)	46.7	12.4	13.8	−5.5	2.3	10.3	32.3	37.3
HHA (n = 3,190)	59.6	10.0	14.1	−9.7	0.0	8.0	29.5	34.1
IRF (n = 4,158)	43.6	15.5	12.5	0.0	6.2	12.8	35.4	39.2
LTCH (n = 1,968)	33.9	9.9	15.7	−12.1	0.0	7.4	31.1	36.9
SNF (n = 2,749)	45.4	12.4	12.8	−3.6	2.8	10.2	32.2	36.7
Musculoskeletal								
Overall (n = 3,492)	48.4	15.9	13.0	−1.2	6.3	14.2	25.1	39.0
HHA (n = 810)	58.5	14.6	13.7	−6.0	2.4	15.1	25.6	35.4
IRF (n = 1,463)	44.7	17.4	12.5	1.3	8.1	14.8	25.7	40.1
LTCH (n = 122)	41.8	8.6	14.1	−9.7	0.0	8.3	16.4	34.7
SNF (n = 1,097)	46.7	15.5	12.6	−1.1	5.7	13.0	24.7	37.9
Nervous system								
Overall (n = 1,756)	44.3	12.0	12.4	−3.8	3.5	9.7	18.7	35.4
HHA (n = 361)	55.5	7.8	12.5	−9.3	0.0	5.5	15.0	29.6
IRF (n = 1,096)	41.8	13.8	11.9	−1.1	5.5	11.4	20.3	37.3
LTCH (n = 86)	33.1	10.4	13.0	−5.1	2.0	7.7	17.1	32.4
SNF (n = 213)	42.4	10.1	12.9	−7.3	1.3	7.9	16.3	35.4

NOTE: HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

Table 8-9
Mobility: Descriptive information on mobility functional change, by facility type

Setting	Mean admission score	Mean change	Standard deviation of mean change	5th %tile	25th %tile	50th %tile	75th %tile	95th %tile
Overall								
Overall (n = 12,065)	45.1	14.6	14.6	−5.3	4.8	13.2	23.0	41.0
HHA (n = 3,190)	59.9	12.1	16.2	−13.0	0.5	10.1	23.1	40.3
IRF (n = 4,158)	41.2	16.7	11.9	0.5	8.6	15.2	23.2	38.6
LTCH (n = 1,968)	33.5	11.5	14.8	−7.3	0.9	9.7	19.5	38.4
SNF (n = 2,749)	43.4	16.6	15.2	−2.0	5.8	14.5	25.0	47.9
Musculoskeletal								
Overall (n = 3,492)	45.1	19.0	14.0	0.0	9.4	17.6	27.2	45.0
HHA (n = 810)	57.3	16.9	15.8	−7.6	5.1	16.7	28.1	43.1
IRF (n = 1,463)	40.5	19.4	11.7	3.5	11.3	18.1	26.0	40.2
LTCH (n = 122)	37.0	12.1	13.3	−7.1	4.3	10.3	18.5	39.0
SNF (n = 1,097)	43.1	20.7	15.2	0.0	9.8	18.5	30.0	51.6
Nervous system								
Overall (n = 1,756)	43.6	13.4	12.5	−3.5	5.4	12.2	20.7	34.9
HHA (n = 361)	54.0	10.4	14.8	−10.9	0.5	8.4	20.3	33.8
IRF (n = 1,096)	41.1	14.8	11.4	−0.2	7.7	13.0	21.1	35.0
LTCH (n = 86)	33.7	11.2	12.2	−2.7	2.3	9.5	18.7	30.3
SNF (n = 213)	42.7	12.6	12.8	−6.9	3.5	11.3	20.6	37.5

NOTE: HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

Table 8-10
Dependent variable = self-care change, all conditions

Variable	Estimate	Standard error	t value	Pr > |t|
Intercept	31.50	2.32	13.55	<.0001
Provider type				
HHA	4.02	1.21	3.33	0.001
IRF	3.75	1.53	2.46	0.02
LTCH	0.74	1.32	0.56	0.58
SNF (referent)	—	—	—	—
Age				
64 years and under	4.14	0.56	7.46	<.0001
65-74 years	2.76	0.41	6.75	<.0001
75-84 years	1.51	0.34	4.44	<.0001
85 years and above (referent)	—	—	—	—
Race/ethnicity				
Black or African American	−2.05	0.63	−3.25	0.002
Non-Black (referent)	—	—	—	—
Gender				
Male	0.32	0.28	1.13	0.26
Female (referent)	—	—	—	—
Medicaid as secondary payer (FFS or HMO)				
Yes	−0.95	0.74	−1.29	0.20
No (referent)	—	—	—	—
Admitted from immediately prior to CARE stay				
Long-term nursing facility	−1.05	1.20	−0.88	0.38
Short-stay acute hospital	0.13	0.46	0.27	0.79
Any service use in the last 2 months[1]				
LTCH	−0.52	0.80	−0.65	0.52
Home health or outpatient services	−1.21	0.48	−2.52	0.01
SNF	−1.57	0.53	−3.00	0.003
IRF	−1.40	0.68	−2.05	0.04
Short-stay acute hospital	0.46	0.50	0.91	0.36
None	−2.76	0.66	−4.16	<.0001

(continued)

Table 8-10 (continued)
Dependent variable = self-care change, all conditions

Variable	Estimate	Standard error	t value	Pr > |t|
Primary medical diagnosis groups[2]				
No primary diagnosis identified	4.03	1.39	2.90	0.004
Neurologic, stroke	0.72	0.83	0.87	0.39
Neurologic, surgical	0.16	1.02	0.16	0.87
Neurologic, medical	−0.59	0.70	−0.84	0.41
Respiratory, ventilator and tracheostomy	1.75	1.09	1.61	0.11
Respiratory, surgical	3.78	1.47	2.57	0.01
Respiratory, medical	−0.12	0.76	−0.16	0.87
Respiratory, COPD	0.37	1.15	0.32	0.75
Cardiovascular, vascular surgical	1.55	0.95	1.63	0.11
Cardiovascular, cardiac surgical	2.43	0.85	2.86	0.01
Cardiovascular, general	−0.05	0.88	−0.05	0.96
Cardiovascular, vascular medical	−1.28	1.57	−0.82	0.41
Cardiovascular, cardiac medical	0.89	0.73	1.22	0.22
Orthopedic, minor surgical	0.88	0.80	1.10	0.27
Orthopedic, major surgical	3.90	0.95	4.11	<.0001
Orthopedic, spinal	3.44	1.17	2.94	0.004
Orthopedic, minor medical	0.55	0.84	0.65	0.52
Orthopedic, major medical	0.75	1.35	0.55	0.58
Integumentary, surgical	0.46	1.27	0.36	0.72
Integumentary, medical	−0.78	0.83	−0.94	0.35
Endocrine, surgical	−0.76	2.04	−0.37	0.71
Endocrine, medical	0.61	0.95	0.64	0.52
Kidney and urinary, surgical	1.06	1.61	0.66	0.51
Kidney and urinary, medical	−2.07	0.85	−2.43	0.02
Infections, surgical	0.05	1.35	0.04	0.97
Infections, medical	−2.25	1.76	−1.28	0.20
Infections, septicemia	−1.04	1.07	−0.97	0.33
Transplant	9.57	2.85	3.35	0.001
GI and hepatobiliary, minor surgical	3.70	1.13	3.28	0.001
GI and hepatobiliary, major surgical	2.91	1.04	2.79	0.01
GI and hepatobiliary, minor medical	0.01	0.80	0.01	0.99
GI and hepatobiliary, major medical	0.12	1.02	0.12	0.90

(continued)

Table 8-10 (continued)
Dependent variable = self-care change, all conditions

Variable	Estimate	Standard error	t value	Pr > |t|
Hematologic, surgical	1.48	3.21	0.46	0.65
Hematologic, medical	−2.23	1.79	−1.24	0.22
Other, surgical	0.97	0.95	1.02	0.31
Other, medical (referent)	—	—	—	—
Comorbid condition categories[3]				
Cellulitis (HCC120,164)	−0.17	0.69	−0.25	0.80
Shock, ischemic HD, vascular (HCC84,86,87,106,107,108)	−0.27	0.40	−0.67	0.51
Metabolic, diabetes, other endocrine (HCC21,23,24,17,18,19,20,26)	−0.51	0.27	−1.91	0.06
Liver, other GI (HCC27,28,30,29,31,32,33,34,35)	0.49	0.35	1.40	0.16
Head and spine injury (HCC166,167,70,71,72)	−2.06	0.89	−2.31	0.02
Morbid obesity (HCC22)	0.05	0.79	0.06	0.95
Orthopedic infection, rheumatoid arthritis, severe skeletal, musculoskeletal, amputation (HCC39,40,41,42,43,44,45,189)	0.13	0.37	0.34	0.73
Polyneuropathy, seizure, other neurological (HCC75,79,73,74,76,77,78)	−0.91	0.45	−2.01	0.05
Psychiatric/depression (HCC54,57,58,59,60,55,56)	0.70	0.50	1.40	0.17
Acute and chronic renal (HCC135,136,137,138)	−1.31	0.65	−2.01	0.05
Pneumonia, pleural effusion, other respiratory (HCC114,115,116,117,110,111,112)	0.03	0.32	0.10	0.92
Stroke (HCC99,100,101,102,103,104)	−1.59	0.54	−2.94	0.004
UTI (HCC141,144)	−0.43	0.41	−1.04	0.30
Major treatments				
Hemodialysis	−2.19	0.84	−2.60	0.01
Ventilator (weaning or non-weaning)	0.20	1.12	0.18	0.86
Severe pressure ulcer present[4]				
Yes	−3.32	0.73	−4.57	<.0001
No (referent)	—	—	—	—
Turning surfaces—at least one not intact				
Yes	−0.67	0.71	−0.95	0.35
No (referent)	—	—	—	—

(continued)

Table 8-10 (continued)
Dependent variable = self-care change, all conditions

Variable	Estimate	Standard error	t value	Pr > |t|
Cognitive status (BIMS)[5]				
Severe cognitive impairment	−2.68	0.42	−6.32	<.0001
Prior functioning[6]				
Self-care function: dependent	−5.48	0.73	−7.53	<.0001
Mobility (ambulation): dependent	1.19	0.70	1.70	0.09
Mobility (wheelchair): dependent or need some help	−3.96	0.44	−9.10	<.0001
Bowel: assistance needed with device				
Yes	−3.84	0.71	−5.41	<.0001
Bladder: indwelling or external device used				
Yes	−1.64	0.36	−4.53	<.0001
Swallowing[7]				
Signs and symptoms of disorder present	−2.09	0.66	−3.14	0.002
Swallowing: NPO—intake not by mouth	−2.70	0.93	−2.92	0.004
No (referent)	—	—	—	—
Expression of ideas and wants				
Without difficulty	2.52	0.42	5.96	<.0001
With any difficulty or unable to assess (referent)	—	—	—	—
Ability to see in adequate light				
Severely impaired	−2.70	0.74	−3.66	0.0004
Not severely impaired (referent)	—	—	—	—
Unable to assess, unknown, missing	0.15	0.88	0.17	0.86
Ability to hear				
Severely impaired	−1.56	0.99	−1.58	0.12
Not severely impaired (referent)	—	—	—	—
Unable to assess, unknown, missing	−4.03	1.17	−3.43	0.001
Respiratory status[8]				
Impaired	−1.05	0.30	−3.52	0.001
Sitting endurance[9]				
No, could not do	−3.96	0.58	−6.77	<.0001
Yes, can do with support	−1.25	0.46	−2.75	0.01
Yes, can do without support (referent)	—	—	—	—
Not assessed due to medical restriction	−3.42	0.80	−4.27	<.0001
Depression present[10]				
Yes	−1.29	0.51	−2.53	0.01
No (referent)	—	—	—	—
No interview, comatose, or missing	−2.04	0.56	−3.65	0.0004

(continued)

Table 8-10 (continued)
Dependent variable = self-care change, all conditions

Variable	Estimate	Standard error	t value	Pr > |t|
Function scores[11]				
Independence in self-care at admission	−0.43	0.03	−15.32	<.0001

1 Patients may have received services from more than one provider type in the 2 months prior to the CARE admission. There is no referent group because the item was "Check All that Apply." Hospice and psychiatric hospitals were excluded because of small sample size.

2 Primary diagnosis is determined based on the MS-DRG reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the PAC claim was grouped into an MS-DRG.

3 Comorbidities are based on the diagnoses listed on the CARE admission assessment.

4 Severe pressure ulcers are defined as presence of any stage 3, 4, or unstageable pressure ulcer, or a stage 2 pressure ulcer that has been present for more than 2 months.

5 Patients are considered to be severely cognitively impaired if they received a score of less than 8 on the Brief Interview for Mental Status (BIMS). Patients who did not receive an interview and who were only able to recall one item, or who could recall only two but could not recall that they were "in a hospital, nursing home, or home" on the observational assessment of cognitive status were also considered to be severely cognitively impaired. Patients who scored from 8 to 12 on the BIMS or who could recall two items on the observational assessment including that they were "in a hospital, nursing home, or home" were considered moderately impaired.

6 Prior functioning: Clinicians reported on the patient's usual ability prior to the current illness, exacerbation, or injury. Self-care includes bathing, dressing, using the toilet, and eating. Mobility (ambulation) includes walking from room to room with or without devices such as cane, crutch, or walker. Mobility (wheelchair) includes moving from room to room using a wheelchair, scooter, or other wheeled mobility device. Patients were classified as "independent," "needed partial assistance," or "dependent" on these items. Patients were considered independent if they completed the activities by themselves, with or without an assistive device, with no assistance from a helper. Patients were considered dependent if a helper completed the activity for the patient.

7 Patients are considered to have symptoms of a possible swallowing disorder if the assessment was marked as "Coughing or choking during meals or when swallowing medications," "Holding food in mouth/cheeks or residual food in mouth after meals," or "Loss of liquids/solids from mouth when eating or drinking."

8 Patients are considered to have impaired respiratory status where respiratory status was evaluated while the patient was using supplemental oxygen, and, for patients where status was only reported for activity without supplemental oxygen, if the patient was dyspneic or noticeably short of breath with minimal or less exertion. Patients on ventilators are included in a separate category.

9 Patients were evaluated on their ability to tolerate sitting for 15 minutes to determine sitting endurance.

10 Patients were considered depressed if they reported being sad "often" or "always" in the 2 weeks prior to the assessment interview. Patients who were unable to respond were grouped with the "comatose, no interview or missing" category.

11 The function score is a continuous measure of a patient's independence in function, with a range from 1 (most dependent) to 100 (most independent).

NOTE: N = 12, 065, R-squared = 0.22. BIMS = Brief Interview for Mental Status; CARE = Continuity Assessment Record and Evaluation; COPD = chronic obstructive pulmonary disease; FFS = fee-for-service; GI = gastrointestinal bleeding; HCC = hierarchical condition categories; HHA = home health agency; HMO = health maintenance organization; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; NPO = no intake by mouth; SNF = skilled nursing facility; UTI = urinary tract infection.
SOURCE: RTI analysis of Phase 1 CARE assessments and Medicare claims (care_cs223).

Table 8-11
Dependent variable = self-care change, musculoskeletal patients

Variable	Estimate	Standard error	t value	Pr > |t|
Intercept	35.12	3.99	8.81	<.0001
Provider type				
HHA	4.35	1.89	2.30	0.02
IRF	3.10	2.05	1.51	0.13
LTCH	−1.91	2.15	−0.89	0.37
SNF (referent)	—	—	—	—
Age				
64 years and under	3.79	0.93	4.09	<.0001
65-74 years	3.30	0.68	4.86	<.0001
75-84 years	2.45	0.62	3.94	0.0001
85 years and above (referent)	—	—	—	—
Race/ethnicity				
Black or African American	−0.95	1.18	−0.80	0.42
Non-Black (referent)	—	—	—	—
Gender				
Male	0.43	0.44	0.97	0.33
Female (referent)	—	—	—	—
Medicaid as secondary payer (FFS or HMO)				
Yes	1.45	1.38	1.04	0.30
No (referent)	—	—	—	—
Admitted from immediately prior to CARE stay				
Long-term nursing facility	−3.71	1.64	−2.27	0.03
Short-stay acute hospital	−0.78	0.93	−0.83	0.41
Any service use in the last 2 months[1]				
LTCH	−1.57	1.82	−0.86	0.39
Home health or outpatient services	−2.05	0.78	−2.62	0.01
SNF	−1.93	0.89	−2.16	0.03
IRF	−1.24	1.05	−1.18	0.24
Short-stay acute hospital	−2.06	1.05	−1.95	0.05
None	−4.22	1.66	−2.53	0.01

(continued)

Table 8-11 (continued)
Dependent variable = self-care change, musculoskeletal patients

Variable	Estimate	Standard error	t value	Pr > |t|
Primary medical diagnosis groups[2]				
Orthopedic, minor surgical	0.45	1.09	0.41	0.68
Orthopedic, major surgical	3.37	1.30	2.59	0.01
Orthopedic, spinal	3.46	1.35	2.56	0.01
Orthopedic, minor medical	−0.55	1.16	−0.48	0.63
Orthopedic, major medical (referent)	—	—	—	—
Comorbid condition categories[3]				
Cellulitis (HCC120,164)	1.98	1.28	1.55	0.12
Shock, ischemic heart disease, vascular (HCC84,86,87,106,107,108)	−0.72	0.74	−0.98	0.33
Metabolic, diabetes, other endocrine (HCC21,23,24,17,18,19,20,26)	−0.24	0.39	−0.62	0.54
Liver, other GI (HCC27,28,30,29,31,32,33,34,35)	0.24	0.54	0.44	0.66
Head and spine injury (HCC166,167,70,71,72)	−3.93	1.64	−2.40	0.02
Morbid obesity (HCC22)	−1.29	1.20	−1.08	0.28
Orthopedic infection, rheumatoid arthritis, severe skeletal, musculoskeletal, amputation (HCC39,40,41,42,43,44,45,189)	0.17	0.82	0.20	0.84
Polyneuropathy, seizure, other neurological (HCC75,79,73,74,76,77,78)	−1.36	0.77	−1.78	0.08
Psychiatric/depression (HCC54,57,58,59,60,55,56)	−0.90	0.84	−1.07	0.29
Acute and chronic renal (HCC135,136,137,138)	−1.10	1.15	−0.95	0.34
Pneumonia, pleural effusion, other respiratory (HCC114,115,116,117,110,111,112)	−0.30	0.56	−0.54	0.59
Stroke (HCC99,100,101,102,103,104)	−1.81	1.10	−1.65	0.10
UTI (HCC141,144)	−0.74	0.73	−1.02	0.31
Major treatments				
Hemodialysis	−4.35	2.03	−2.14	0.03
Ventilator (weaning or non-weaning)	0.00	0.00	0.00	0.00
Severe pressure ulcer present[4]				
Yes	−3.98	1.63	−2.44	0.02
No (referent)	—	—	—	—

(continued)

Table 8-11 (continued)
Dependent variable = self-care change, musculoskeletal patients

Variable	Estimate	Standard error	t value	Pr > |t|
Turning surfaces—at least one not intact				
Yes	−0.68	1.11	−0.61	0.54
No	—	—	—	—
Cognitive status (BIMS)[5]				
Severe cognitive impairment	−4.26	1.06	−4.01	0.0001
Prior functioning[6]				
Self-care function: dependent	−4.28	1.38	−3.10	0.002
Mobility (ambulation): Dependent	1.71	1.37	1.24	0.22
Mobility (wheelchair): Dependent or need some help	−3.60	0.84	−4.26	<.0001
Bowel: Assistance needed with device				
Yes	−1.71	1.11	−1.54	0.13
Bladder: Indwelling or external device used				
Yes	−1.59	0.61	−2.63	0.01
Swallowing[7]				
Signs and symptoms of disorder present	−4.30	1.13	−3.80	0.0002
Swallowing: NPO—intake not by mouth	−7.08	5.52	−1.28	0.20
No (referent)	—	—	—	—
Expression of ideas and wants				
Without difficulty	2.72	0.64	4.29	<.0001
With any difficulty or unable to assess (referent)	—	—	—	—
Ability to see in adequate light				
Severely impaired	−1.53	1.81	−0.85	0.40
Not severely impaired (referent)	—	—	—	—
Unable to assess, unknown, missing	1.26	2.05	0.61	0.54
Ability to hear				
Severely impaired	−0.27	2.31	−0.12	0.91
Not severely impaired (referent)	—	—	—	—
Unable to assess, unknown, missing	−4.34	2.37	−1.83	0.07
Respiratory status[8]				
Impaired	−1.46	0.67	−2.20	0.03
Sitting endurance[9]				
No, could not do	−4.75	1.05	−4.52	<.0001
Yes, can do with support	−1.92	0.72	−2.66	0.01
Yes, can do without support (referent)	—	—	—	—
Not assessed due to medical restriction	−2.69	2.12	−1.27	0.21
Depression present[10]				
Yes	−2.54	0.87	−2.93	0.004
No (referent)	—	—	—	—
No interview, comatose or missing	−2.03	0.78	−2.60	0.01

(continued)

Table 8-11 (continued)
Dependent variable = self-care change, musculoskeletal patients

Variable	Estimate	Standard error	t value	Pr > |t|
Function scores[11]				
Independence in self-care at admission	−0.44	0.05	−8.42	<.0001

1 Patients may have received services from more than one provider type in the 2 months prior to the CARE admission. There is no referent group because the item was "Check All that Apply." Hospice and psychiatric hospitals were excluded because of small sample size.

2 Primary diagnosis is determined based on the MS-DRG reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the PAC claim was grouped into an MS-DRG.

3 Comorbidities are based on the diagnoses listed on the CARE admission assessment.

4 Severe pressure ulcers are defined as presence of any stage 3, 4, or unstageable pressure ulcer, or a stage 2 pressure ulcer that has been present for more than 2 months.

5 Patients are considered to be severely cognitively impaired if they received a score of less than 8 on the Brief Interview for Mental Status (BIMS). Patients who did not receive an interview and who were only able to recall one item, or who could recall only two but could not recall that they were "in a hospital, nursing home, or home" on the observational assessment of cognitive status were also considered to be severely cognitively impaired. Patients who scored from 8 to 12 on the BIMS or who could recall two items on the observational assessment including that they were "in a hospital, nursing home, or home" were considered moderately impaired.

6 Prior functioning: Clinicians reported on the patient's usual ability prior to the current illness, exacerbation, or injury. Self-care includes bathing, dressing, using the toilet, and eating. Mobility (ambulation) includes walking from room to room with or without devices such as cane, crutch, or walker. Mobility (wheelchair) includes moving from room to room using a wheelchair, scooter, or other wheeled mobility device. Patients were classified as "independent," "needed partial assistance," or "dependent" on these items. Patients were considered independent if they completed the activities by themselves, with or without an assistive device, with no assistance from a helper. Patients were considered dependent if a helper completed the activity for the patient.

7 Patients are considered to have symptoms of a possible swallowing disorder if the assessment was marked as "Coughing or choking during meals or when swallowing medications," "Holding food in mouth/cheeks or residual food in mouth after meals," or "Loss of liquids/solids from mouth when eating or drinking."

8 Patients are considered to have impaired respiratory status where respiratory status was evaluated while the patient was using supplemental oxygen, and, for patients where status was only reported for activity without supplemental oxygen, if the patient was dyspneic or noticeably short of breath with minimal or less exertion. Patients on ventilators are included in a separate category.

9 Patients were evaluated on their ability to tolerate sitting for 15 minutes to determine sitting endurance.

10 Patients were considered depressed if they reported being sad "often" or "always" in the 2 weeks prior to the assessment interview. Patients who were unable to respond were grouped with the "comatose, no interview, or missing" category.

11 The function score is a continuous measure of a patient's independence in function, with a range from 1 (most dependent) to 100 (most independent).

NOTE: N = 3,492, R-squared = 0.19. BIMS = Brief Interview for Mental Status; CARE = Continuity Assessment Record and Evaluation; FFS = fee-for-service; HCC = hierarchical condition categories; HHA = home health agency; HMO = health maintenance organization; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; NPO = no intake by mouth; SNF = skilled nursing facility; UTI = urinary tract infection.

SOURCE: RTI analysis of Phase 1 CARE assessments and Medicare claims (care_cs223).

Table 8-12
Dependent variable = self-care change, nervous system patients

Variable	Estimate	Standard error	t value	Pr > |t|
Intercept	23.72	2.98	7.97	<.0001
Provider type				
HHA	2.80	1.67	1.68	0.10
IRF	3.93	1.69	2.33	0.02
LTCH	0.67	1.89	0.35	0.72
SNF (referent)	—	—	—	—
Age				
64 years and under	4.55	1.06	4.29	<.0001
65-74 years	3.37	0.79	4.24	<.0001
75-84 years	2.45	0.68	3.61	0.001
85 years and above (referent)	—	—	—	—
Race/ethnicity				
Black or African American	−2.54	1.02	−2.49	0.01
Non-Black (referent)	—	—	—	—
Gender				
Male	0.12	0.63	0.19	0.85
Female (referent)	—	—	—	—
Medicaid as secondary payer (FFS or HMO)				
Yes	−1.71	1.04	−1.65	0.10
No (referent)	—	—	—	—
Admitted from immediately prior to CARE stay				
Long-term nursing facility	−9.50	4.47	−2.13	0.04
Short-stay acute hospital	0.68	1.36	0.50	0.62
Any service use in the last 2 months[1]				
LTCH	0.60	2.30	0.26	0.80
Home health or outpatient services	−1.78	0.81	−2.19	0.03
SNF	−0.20	1.28	−0.15	0.88
IRF	−0.40	1.27	−0.31	0.76
Short-stay acute hospital	0.36	1.20	0.30	0.77
None	−2.72	1.72	−1.58	0.12

(continued)

Table 8-12 (continued)
Dependent variable = self-care change, nervous system patients

Variable	Estimate	Standard error	t value	Pr > |t|
Primary medical diagnosis groups[2]				
Neurologic, stroke	1.06	0.79	1.33	0.19
Neurologic, surgical	0.59	0.92	0.64	0.52
Neurologic, medical (referent)	—	—	—	—
Comorbid condition categories[3]				
Cellulitis (HCC120,164)	−2.84	2.44	−1.16	0.25
Shock, ischemic heart disease, vascular (HCC84,86,87,106,107,108)	−1.16	1.01	−1.15	0.25
Metabolic, diabetes, other endocrine (HCC21,23,24,17,18,19,20,26)	−0.42	0.67	−0.62	0.54
Liver, other GI (HCC27,28,30,29,31,32,33,34,35)	0.01	0.75	0.02	0.99
Head and spine injury (HCC166,167,70,71,72)	1.76	1.43	1.23	0.22
Morbid obesity (HCC22)	1.97	1.70	1.16	0.25
Orthopedic infection, rheumatoid arthritis, severe skeletal, musculoskeletal, amputation (HCC39,40,41,42,43,44,45,189)	0.60	0.63	0.96	0.34
Polyneuropathy, seizure, other neurological (HCC75,79,73,74,76,77,78)	−1.70	0.69	−2.47	0.02
Psychiatric/depression (HCC54,57,58,59,60,55,56)	−0.24	1.01	−0.24	0.81
Acute and chronic renal (HCC135,136,137,138)	−0.73	1.36	−0.54	0.59
Pneumonia, pleural effusion, other respiratory (HCC114,115,116,117,110,111,112)	0.94	0.87	1.08	0.28
Stroke (HCC99,100,101,102,103,104)	−1.04	0.74	−1.41	0.16
UTI (HCC141,144)	−1.26	0.93	−1.36	0.18
Major treatments				
Hemodialysis	−2.87	2.17	−1.32	0.19
Ventilator (weaning or non-weaning)	6.71	2.48	2.70	0.01
Severe pressure ulcer present[4]				
Yes	−5.74	1.78	−3.22	0.002
No (referent)	—	—	—	—
Turning surfaces—at least one not intact				
Yes	−0.63	0.87	−0.72	0.47
No	—	—	—	—
Cognitive status (BIMS with observational assessment)[5]				
Severe cognitive impairment	−1.65	0.94	−1.77	0.08

(continued)

Table 8-12 (continued)
Dependent variable = self-care change, nervous system patients

Variable	Estimate	Standard error	t value	Pr > |t|
Prior functioning[6]				
Self-care function: Dependent	−2.29	1.85	−1.24	0.22
Mobility (ambulation): Dependent	−3.51	1.85	−1.89	0.06
Mobility (wheelchair): Dependent or need some help	−2.26	0.91	−2.47	0.02
Bowel: Assistance needed with device				
Yes	−2.91	0.88	−3.29	0.001
Bladder: Indwelling or external device used				
Yes	−1.25	0.72	−1.73	0.09
Swallowing[7]				
Signs and symptoms of disorder present	−0.99	0.95	−1.04	0.30
Swallowing: NPO—intake not by mouth	0.12	1.47	0.08	0.94
No (referent)	—	—	—	—
Expression of ideas and wants				
Without difficulty	2.04	0.66	3.07	0.003
With any difficulty or unable to assess (referent)	—	—	—	—
Ability to ability to see in adequate light				
Severely impaired	−1.01	1.95	−0.52	0.60
Unable to assess, unknown, missing	—	—	—	—
Not severely impaired (referent)	2.48	1.57	1.59	0.12
Ability to hear				
Severely impaired	0.99	2.17	0.46	0.65
Not severely impaired (referent)	—	—	—	—
Unable to assess, unknown, missing	−2.04	2.72	−0.75	0.45
Respiratory status[8]				
Impaired	−0.41	0.77	−0.53	0.60
Sitting endurance[9]				
No, could not do	−1.31	1.13	−1.16	0.25
Yes, can do with support	−1.22	0.73	−1.66	0.10
Yes, can do without support (referent)	—	—	—	—
Not assessed due to medical restriction	−3.49	1.88	−1.85	0.07
Depression present[10]				
Yes	−0.63	0.93	−0.67	0.50
No (referent)	—	—	—	—
No interview, comatose or missing	−2.23	0.97	−2.30	0.02

(continued)

Table 8-12 (continued)
Dependent variable = self-care change, nervous system patients

Variable	Estimate	Standard error	t value	Pr > |t|
Function scores[11]				
Independence in self-care at admission	−0.32	0.03	−9.47	<.0001

1 Patients may have received services from more than one provider type in the 2 months prior to the CARE admission. There is no referent group because the item was "Check All that Apply." Hospice and psychiatric hospitals were excluded because of small sample size.
2 Primary diagnosis is determined based on the MS-DRG reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the PAC claim was grouped into an MS-DRG.
3 Comorbidities are based on the diagnoses listed on the CARE admission assessment.
4 Severe pressure ulcers are defined as presence of any stage 3, 4, or unstageable pressure ulcer, or a stage 2 pressure ulcer that has been present for more than 2 months.
5 Patients are considered to be severely cognitively impaired if they received a score of less than 8 on the Brief Interview for Mental Status (BIMS). Patients who did not receive an interview and who were only able to recall one item, or who could recall only two but could not recall that they were "in a hospital, nursing home, or home" on the observational assessment of cognitive status were also considered to be severely cognitively impaired. Patients who scored from 8 to 12 on the BIMS or who could recall two items on the observational assessment including that they were "in a hospital, nursing home, or home" were considered moderately impaired.
6 Prior functioning: Clinicians reported on the patient's usual ability prior to the current illness, exacerbation, or injury. Self-care includes bathing, dressing, using the toilet, and eating. Mobility (ambulation) includes walking from room to room with or without devices such as cane, crutch, or walker. Mobility (wheelchair) includes moving from room to room using a wheelchair, scooter, or other wheeled mobility device. Patients were classified as "independent," "needed partial assistance," or "dependent" on these items. Patients were considered independent if they completed the activities by themselves, with or without an assistive device, with no assistance from a helper. Patients were considered dependent if a helper completed the activity for the patient.
7 Patients are considered to have symptoms of a possible swallowing disorder if the assessment was marked as "Coughing or choking during meals or when swallowing medications," "Holding food in mouth/cheeks or residual food in mouth after meals," or "Loss of liquids/solids from mouth when eating or drinking."
8 Patients are considered to have impaired respiratory status where respiratory status was evaluated while the patient was using supplemental oxygen, and, for patients where status was only reported for activity without supplemental oxygen, if the patient was dyspneic or noticeably short of breath with minimal or less exertion. Patients on ventilators are included in a separate category.
9 Patients were evaluated on their ability to tolerate sitting for 15 minutes to determine sitting endurance.
10 Patients were considered depressed if they reported being sad "often" or "always" in the 2 weeks prior to the assessment interview. Patients who were unable to respond were grouped with the "comatose, no interview, or missing" category.
11 The function score is a continuous measure of a patient's independence in function, with a range from 1 (most dependent) to 100 (most independent).

NOTE: N = 1, 756, R-squared = 0.17. BIMS = Brief Interview for Mental Status; CARE = Continuity Assessment Record and Evaluation; FFS = fee-for-service; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; NPO = no intake by mouth; SNF = skilled nursing facility; UTI = urinary tract infection.
SOURCE: RTI analysis of Phase 1 CARE assessments and Medicare claims (care_cs223).

Table 8-13
Dependent variable = mobility change, all conditions

Variable	Estimate	Standard error	t value	Pr > |t|
Intercept	37.15	2.17	17.10	<.0001
Provider type				
HHA	2.52	1.34	1.88	0.06
IRF	0.78	1.53	0.51	0.61
LTCH	−0.19	1.58	−0.12	0.91
SNF (referent)	—	—	—	—
Age				
64 years and under	3.27	0.60	5.45	<.0001
65-74 years	2.53	0.40	6.38	<.0001
75-84 years	1.30	0.38	3.40	0.001
85 years and above (referent)	—	—	—	—
Race/ethnicity				
Black or African American	−1.96	0.55	−3.60	0.001
Non-Black (referent)	—	—	—	—
Gender				
Male	−0.42	0.29	−1.44	0.15
Female (referent)	—	—	—	—
Medicaid as secondary payer (FFS or HMO)				
Yes	−0.83	0.66	−1.25	0.21
No (referent)	—	—	—	—
Admitted from immediately prior to CARE stay				
Long-term nursing facility	−1.69	1.44	−1.17	0.24
Short-stay acute hospital	0.01	0.58	0.01	0.99
Any service use in the last 2 months[1]				
LTCH	−1.83	0.95	−1.92	0.06
Home health or outpatient services	−1.74	0.49	−3.52	0.001
SNF	−1.84	0.59	−3.14	0.002
IRF	−1.52	0.64	−2.38	0.02
Short-stay acute hospital	1.01	0.58	1.73	0.09
None	−2.36	0.83	−2.83	0.01

(continued)

Table 8-13 (continued)
Dependent variable = mobility change, all conditions

Variable	Estimate	Standard error	t value	Pr > |t|
Primary medical diagnosis groups[2]				
No primary diagnosis identified	2.18	1.67	1.30	0.19
Neurologic, stroke	−0.27	0.89	−0.30	0.76
Neurologic, surgical	−1.14	1.04	−1.09	0.28
Neurologic, medical	−1.47	0.70	−2.10	0.04
Respiratory, ventilator and tracheostomy	1.24	0.99	1.25	0.21
Respiratory, surgical	3.13	1.35	2.32	0.02
Respiratory, medical	−0.83	0.81	−1.02	0.31
Respiratory, COPD	−2.76	1.26	−2.19	0.03
Cardiovascular, vascular surgical	0.07	1.01	0.07	0.95
Cardiovascular, cardiac surgical	1.57	1.00	1.57	0.12
Cardiovascular, general	−1.47	0.93	−1.58	0.12
Cardiovascular, vascular medical	−1.24	1.58	−0.79	0.43
Cardiovascular, cardiac medical	−0.44	0.87	−0.50	0.62
Orthopedic, minor surgical	−0.76	0.77	−0.99	0.32
Orthopedic, major surgical	3.34	1.05	3.20	0.002
Orthopedic, spinal	2.76	1.01	2.72	0.008
Orthopedic, minor medical	−0.35	0.75	−0.46	0.64
Orthopedic, major medical	0.62	1.37	0.46	0.65
Integumentary, surgical	−0.54	1.35	−0.40	0.69
Integumentary, medical	−2.71	0.94	−2.89	0.005
Endocrine, surgical	−6.05	2.13	−2.83	0.01
Endocrine, medical	−1.09	0.89	−1.22	0.22
Kidney and urinary, surgical	2.40	2.11	1.14	0.26
Kidney and urinary, medical	−2.37	0.85	−2.80	0.01
Infections, surgical	−1.42	1.31	−1.09	0.28
Infections, medical	−0.13	2.00	−0.06	0.95
Infections, septicemia	−2.52	0.98	−2.56	0.01
Transplant	7.02	3.53	1.99	0.05
GI and hepatobiliary, minor surgical	1.85	1.20	1.54	0.13
GI and hepatobiliary, major surgical	1.86	1.04	1.79	0.08
GI and hepatobiliary, minor medical	−0.43	1.10	−0.39	0.70
GI and hepatobiliary, major medical	−1.07	1.19	−0.90	0.37

(continued)

Table 8-13 (continued)
Dependent variable = mobility change, all conditions

Variable	Estimate	Standard error	t value	Pr > |t|
Hematologic, surgical	−2.26	3.21	−0.70	0.48
Hematologic, medical	−3.69	1.63	−2.26	0.03
Other, surgical	0.40	1.14	0.35	0.73
Other, medical (referent)	—	—	—	—
Comorbid condition categories[3]				
Cellulitis (HCC120,164)	0.36	0.70	0.51	0.61
Shock, ischemic heart disease, vascular (HCC84,86,87,106,107,108)	−1.11	0.37	−2.99	0.003
Metabolic, diabetes, other endocrine (HCC21,23,24,17,18,19,20,26)	−0.61	0.28	−2.16	0.03
Liver, other GI (HCC27,28,30,29,31,32,33,34,35)	0.57	0.35	1.66	0.10
Head and spine injury (HCC166,167,70,71,72)	−1.79	0.96	−1.87	0.06
Morbid obesity (HCC22)	−0.04	0.66	−0.06	0.95
Orthopedic infection, rheumatoid arthritis, severe skeletal, musculoskeletal, amputation (HCC39,40,41,42,43,44,45,189)	0.01	0.36	0.02	0.98
Polyneuropathy, seizure, other neurological (HCC75,79,73,74,76,77,78)	−0.81	0.42	−1.95	0.05
Psychiatric/depression (HCC54,57,58,59,60,55,56)	0.65	0.44	1.47	0.14
Acute and chronic renal (HCC135,136,137,138)	−1.70	0.66	−2.55	0.01
Pneumonia, pleural effusion, other respiratory (HCC114,115,116,117,110,111,112)	0.24	0.36	0.66	0.51
Stroke (HCC99,100,101,102,103,104)	−1.71	0.53	−3.20	0.002
UTI (HCC141,144)	−1.15	0.33	−3.51	0.001
Major treatments				
Hemodialysis	−2.01	0.93	−2.15	0.03
Ventilator (weaning or non-weaning)	−0.69	0.95	−0.72	0.47
Severe pressure ulcer present[4]				
Yes	−4.02	0.71	−5.64	<.0001
No (referent)	—	—	—	—
Turning surfaces—at least one not intact				
Yes	−0.85	0.55	−1.54	0.13
No	—	—	—	—
Cognitive status (BIMS)[5]				
Severe cognitive impairment	−1.63	0.47	−3.48	0.001

(continued)

Table 8-13 (continued)
Dependent variable = mobility change, all conditions

Variable	Estimate	Standard error	t value	Pr > |t|
Prior functioning[6]				
Self-care function: dependent	−5.53	0.65	−8.49	<.0001
Mobility (ambulation): dependent	1.15	0.77	1.49	0.14
Mobility (wheelchair): dependent or need some help	−4.88	0.54	−9.08	<.0001
Bowel: assistance needed with device				
Yes	−3.70	0.63	−5.90	<.0001
Bladder: indwelling or external device used				
Yes	−1.82	0.36	−5.00	<.0001
Swallowing[7]				
Signs and symptoms of disorder present	−2.09	0.62	−3.36	0.001
Swallowing: NPO—intake not by mouth	−3.71	0.76	−4.91	<.0001
No (referent)	—	—	—	—
Expression of ideas and wants				
Without difficulty	2.42	0.42	5.76	<.0001
With any difficulty or unable to assess (referent)	—	—	—	—
Ability to see in adequate light				
Severely impaired	−2.52	0.73	−3.46	0.001
Not severely impaired (referent)	—	—	—	—
Unable to assess, unknown, missing	1.01	0.82	1.23	0.22
Ability to hear				
Severely impaired	−1.27	1.08	−1.18	0.24
Not severely impaired (referent)	—	—	—	—
Unable to assess, unknown, missing	−3.50	1.10	−3.17	0.002
Respiratory status[8]				
Impaired	−1.60	0.38	−4.24	<.0001
Sitting endurance[9]				
No, could not do	−3.93	0.64	−6.14	<.0001
Yes, can do with support	−1.83	0.46	−4.00	0.0001
Yes, can do without support (referent)	—	—	—	—
Not assessed due to medical restriction	−3.49	0.85	−4.09	<.0001
Depression present[10]				
Yes	−0.72	0.49	−1.46	0.15
No (referent)	—	—	—	—
No interview, comatose, or missing	−1.39	0.54	−2.56	0.01

(continued)

Table 8-13 (continued)
Dependent variable = mobility change, all conditions

Variable	Estimate	Standard error	t value	Pr > |t|
Function scores[11]				
Independence in mobility at admission	−0.43	0.02	−17.36	<.0001

[1] Patients may have received services from more than one provider type in the 2 months prior to the CARE admission. There is no referent group because the item was "Check All that Apply." Hospice and psychiatric hospitals were excluded because of small sample size.
[2] Primary diagnosis is determined based on the MS-DRG reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the PAC claim was grouped into an MS-DRG.
[3] Comorbidities are based on the diagnoses listed on the CARE admission assessment.
[4] Severe pressure ulcers are defined as presence of any stage 3, 4, or unstageable pressure ulcer, or a stage 2 pressure ulcer that has been present for more than 2 months.
[5] Patients are considered to be severely cognitively impaired if they received a score of less than 8 on the Brief Interview for Mental Status (BIMS). Patients who did not receive an interview and who were only able to recall one item, or who could recall only two but could not recall that they were "in a hospital, nursing home, or home" on the observational assessment of cognitive status were also considered to be severely cognitively impaired. Patients who scored from 8 to 12 on the BIMS or who could recall two items on the observational assessment including that they were "in a hospital, nursing home, or home" were considered moderately impaired.
[6] Prior functioning: Clinicians reported on the patient's usual ability prior to the current illness, exacerbation, or injury. Self-care includes bathing, dressing, using the toilet, and eating. Mobility (ambulation) includes walking from room to room with or without devices such as cane, crutch, or walker. Mobility (wheelchair) includes moving from room to room using a wheelchair, scooter, or other wheeled mobility device. Patients were classified as "independent," "needed partial assistance," or "dependent" on these items. Patients were considered independent if they completed the activities by themselves, with or without an assistive device, with no assistance from a helper. Patients were considered dependent if a helper completed the activity for the patient.
[7] Patients are considered to have symptoms of a possible swallowing disorder if the assessment was marked as "Coughing or choking during meals or when swallowing medications," "Holding food in mouth/cheeks or residual food in mouth after meals," or "Loss of liquids/solids from mouth when eating or drinking."
[8] Patients are considered to have impaired respiratory status where respiratory status was evaluated while the patient was using supplemental oxygen, and, for patients where status was only reported for activity without supplemental oxygen, if the patient was dyspneic or noticeably short of breath with minimal or less exertion. Patients on ventilators are included in a separate category.
[9] Patients were evaluated on their ability to tolerate sitting for 15 minutes to determine sitting endurance.
[10] Patients were considered depressed if they reported being sad "often" or "always" in the 2 weeks prior to the assessment interview. Patients who were unable to respond were grouped with the "comatose, no interview or missing" category.
[11] The function score is a continuous measure of a patient's independence in function, with a range from 1 (most dependent) to 100 (most independent).

NOTE: N = 12,080, R-squared = 0.22. BIMS = Brief Interview for Mental Status; CARE = Continuity Assessment Record and Evaluation; COPD = chronic obstructive pulmonary disease; FFS = fee-for-service; GI = gastrointestinal bleeding; HCC = hierarchical condition categories; HHA = home health agency; HMO = health maintenance organization; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; NPO = no intake by mouth; SNF = skilled nursing facility; UTI = urinary tract infection.
SOURCE: RTI analysis of Phase 1 CARE assessments and Medicare claims (care_cs223).

Table 8-14
Dependent variable = mobility change, musculoskeletal patients

Variable	Estimate	Standard error	t value	Pr > |t|
Intercept	41.54	4.21	9.87	<.0001
Provider type				
HHA	2.53	2.09	1.21	0.23
IRF	−0.40	2.15	−0.18	0.85
LTCH	−3.17	2.28	−1.39	0.17
SNF (referent)	—	—	—	—
Age				
64 years and under	2.65	0.94	2.81	0.01
65-74 years	2.44	0.66	3.68	0.0004
75-84 years	1.70	0.69	2.47	0.02
85 years and above (referent)	—	—	—	—
Race/ethnicity				
Black or African American	−0.68	1.13	−0.60	0.55
Non-Black (referent)	—	—	—	—
Gender				
Male	0.54	0.51	1.05	0.29
Female (referent)	—	—	—	—
Medicaid as secondary payer (FFS or HMO)				
Yes	1.04	1.50	0.69	0.49
No (referent)	—	—	—	—
Admitted from immediately prior to CARE stay				
Long-term nursing facility	−1.50	3.55	−0.42	0.67
Short-stay acute hospital	−0.81	1.14	−0.71	0.48
Any service use in the last 2 months[1]				
LTCH	−3.65	2.11	−1.73	0.09
Home health or outpatient services	−2.82	0.75	−3.76	0.0003
SNF	−0.79	1.08	−0.73	0.47
IRF	−1.00	1.21	−0.83	0.41
Short-stay acute hospital	−1.14	1.21	−0.94	0.35
None	−2.73	1.67	−1.63	0.11

(continued)

Table 8-14 (continued)
Dependent variable = mobility change, musculoskeletal patients

Variable	Estimate	Standard error	t value	Pr > |t|
Primary medical diagnosis groups[2]				
Orthopedic, minor surgical	−1.18	1.14	−1.04	0.30
Orthopedic, major surgical	3.00	1.27	2.36	0.02
Orthopedic, spinal	3.05	1.48	2.05	0.04
Orthopedic, minor medical	−1.14	1.09	−1.04	0.30
Orthopedic, major medical (referent)	—	—	—	—
Comorbid condition categories[3]				
Cellulitis (HCC120,164)	3.45	1.50	2.31	0.02
Shock, ischemic heart disease, vascular (HCC84,86,87,106,107,108)	−1.46	0.71	−2.07	0.04
Metabolic, diabetes, other endocrine (HCC21,23,24,17,18,19,20,26)	−0.46	0.49	−0.94	0.35
Liver, other GI (HCC27,28,30,29,31,32,33,34,35)	0.88	0.50	1.76	0.08
Head and spine injury (HCC166,167,70,71,72)	−1.74	1.42	−1.22	0.22
Morbid obesity (HCC22)	−1.53	0.98	−1.56	0.12
Orthopedic infection, rheumatoid arthritis, severe skeletal, musculoskeletal, amputation (HCC39,40,41,42,43,44,45,189)	−0.05	0.80	−0.06	0.95
Polyneuropathy, seizure, other neurological (HCC75,79,73,74,76,77,78)	−0.72	0.56	−1.28	0.20
Psychiatric/depression (HCC54,57,58,59,60,55,56)	0.27	0.76	0.36	0.72
Acute and chronic renal (HCC135,136,137,138)	−1.58	1.12	−1.41	0.16
Pneumonia, pleural effusion, other respiratory (HCC114,115,116,117,110,111,112)	−0.49	0.62	−0.80	0.43
Stroke (HCC99,100,101,102,103,104)	−2.89	1.03	−2.81	0.01
UTI (HCC141,144)	−2.23	0.61	−3.66	0.0004
Major treatments				
Hemodialysis	−5.30	1.86	−2.85	0.01
Ventilator (weaning or non-weaning)	0.00	0.00	0.00	0.00
Severe pressure ulcer present[4]				
Yes	−4.98	1.44	−3.47	0.001
No (referent)	—	—	—	—
Turning surfaces—at least one not intact				
Yes	−0.42	0.90	−0.47	0.64
No	—	—	—	—

(continued)

Table 8-14 (continued)
Dependent variable = mobility change, musculoskeletal patients

Variable	Estimate	Standard error	t value	Pr > |t|
Cognitive status (BIMS)[5]				
Severe cognitive impairment	−4.18	1.10	−3.80	0.0002
Prior functioning[6]				
Self-care function: Dependent	−5.62	1.71	−3.29	0.001
Mobility (ambulation): Dependent	2.76	1.70	1.62	0.11
Mobility (wheelchair): Dependent or need some help	−5.03	1.12	−4.48	<.0001
Bowel: Assistance needed with device				
Yes	−1.98	1.02	−1.93	0.06
Bladder: Indwelling or external device used				
Yes	−1.59	0.72	−2.22	0.03
Swallowing[7]				
Signs and symptoms of disorder present	−3.89	1.27	−3.06	0.003
Swallowing: NPO—intake not by mouth	−8.64	2.89	−2.99	0.003
No (referent)	—	—	—	—
Expression of ideas and wants				
Without difficulty	2.03	0.59	3.41	0.001
With any difficulty or unable to assess (referent)	—	—	—	—
Ability to see in adequate light				
Severely impaired	−3.45	1.61	−2.14	0.03
Not severely impaired (referent)	—	—	—	—
Unable to assess, unknown, missing	2.69	2.14	1.26	0.21
Ability to hear				
Severely impaired	0.95	2.37	0.40	0.69
Not severely impaired (referent)	—	—	—	—
Unable to assess, unknown, missing	−3.50	3.44	−1.02	0.31
Respiratory status[8]				
Impaired	−1.02	0.71	−1.45	0.15
Sitting endurance[9]				
No, could not do	−3.93	1.25	−3.14	0.0021
Yes, can do with support	−2.57	0.73	−3.53	0.001
Yes, can do without support (referent)	—	—	—	—
Not assessed due to medical restriction	−4.58	1.44	−3.19	0.002
Depression present[10]				
Yes	−3.06	0.76	−4.02	0.0001
No (referent)	—	—	—	—
No interview, comatose or missing	−1.66	1.04	−1.60	0.11

(continued)

Table 8-14 (continued)
Dependent variable = mobility change, musculoskeletal patients

Variable	Estimate	Standard error	t value	Pr > |t|
Function scores[11]				
Independence in mobility at admission	-0.47	0.04	-10.72	<.0001

1 Patients may have received services from more than one provider type in the 2 months prior to the CARE admission. There is no referent group because the item was "Check All that Apply." Hospice and psychiatric hospitals were excluded because of small sample size.

2 Primary diagnosis is determined based on the MS-DRG reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the PAC claim was grouped into an MS-DRG.

3 Comorbidities are based on the diagnoses listed on the CARE admission assessment.

4 Severe pressure ulcers are defined as presence of any stage 3, 4, or unstageable pressure ulcer, or a stage 2 pressure ulcer that has been present for more than 2 months.

5 Patients are considered to be severely cognitively impaired if they received a score of less than 8 on the Brief Interview for Mental Status (BIMS). Patients who did not receive an interview and who were only able to recall one item, or who could recall only two but could not recall that they were "in a hospital, nursing home, or home" on the observational assessment of cognitive status were also considered to be severely cognitively impaired. Patients who scored from 8 to 12 on the BIMS or who could recall two items on the observational assessment including that they were "in a hospital, nursing home, or home" were considered moderately impaired.

6 Prior functioning: Clinicians reported on the patient's usual ability prior to the current illness, exacerbation, or injury. Self-care includes bathing, dressing, using the toilet, and eating. Mobility (ambulation) includes walking from room to room with or without devices such as cane, crutch, or walker. Mobility (wheelchair) includes moving from room to room using a wheelchair, scooter, or other wheeled mobility device. Patients were classified as "independent," "needed partial assistance," or "dependent" on these items. Patients were considered independent if they completed the activities by themselves, with or without an assistive device, with no assistance from a helper. Patients were considered dependent if a helper completed the activity for the patient.

7 Patients are considered to have symptoms of a possible swallowing disorder if the assessment was marked as "Coughing or choking during meals or when swallowing medications," "Holding food in mouth/cheeks or residual food in mouth after meals," or "Loss of liquids/solids from mouth when eating or drinking."

8 Patients are considered to have impaired respiratory status where respiratory status was evaluated while the patient was using supplemental oxygen, and, for patients where status was only reported for activity without supplemental oxygen, if the patient was dyspneic or noticeably short of breath with minimal or less exertion. Patients on ventilators are included in a separate category.

9 Patients were evaluated on their ability to tolerate sitting for 15 minutes to determine sitting endurance.

10 Patients were considered depressed if they reported being sad "often" or "always" in the 2 weeks prior to the assessment interview. Patients who were unable to respond were grouped with the "comatose, no interview, or missing" category.

11 The function score is a continuous measure of a patient's independence in function, with a range from 1 (most dependent) to 100 (most independent).

NOTE: N = 3,491, R-squared = 0.19. BIMS = Brief Interview for Mental Status; CARE = Continuity Assessment Record and Evaluation; HCC = hierarchical condition categories; HHA = home health agency; HMO = health maintenance organization; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; NPO = no intake by mouth; SNF = skilled nursing facility; UTI = urinary tract infection.
SOURCE: RTI analysis of Phase 1 CARE assessments and Medicare claims (care_cs223).

Table 8-15
Dependent variable = mobility change, nervous system patients

Variable	Estimate	Standard error	t value	Pr > |t|
Intercept	24.58	3.09	7.95	<.0001
Provider type				
HHA	2.88	1.85	1.56	0.12
IRF	2.11	1.52	1.39	0.17
LTCH	0.25	1.91	0.13	0.90
SNF (referent)	—	—	—	—
Age				
64 years and under	3.91	1.22	3.20	0.002
65-74 years	2.95	0.93	3.16	0.002
75-84 years	2.04	0.75	2.73	0.01
85 years and above (referent)	—	—	—	—
Race/ethnicity				
Black or African American	−2.23	0.99	−2.25	0.03
Non-Black (referent)	—	—	—	—
Gender				
Male	−0.40	0.67	−0.60	0.55
Female (referent)	—	—	—	—
Medicaid as secondary payer (FFS or HMO)				
Yes	−1.05	1.05	−1.01	0.32
No (referent)	—	—	—	—
Admitted from immediately prior to CARE stay				
Long-term nursing facility	−11.64	4.54	−2.56	0.01
Short-stay acute hospital	2.38	1.21	1.96	0.05
Any service use in the last 2 months[1]				
LTCH	0.66	2.42	0.27	0.79
Home health or outpatient services	−1.80	1.00	−1.80	0.07
SNF	0.17	1.26	0.13	0.89
IRF	−0.50	1.57	−0.32	0.75
Short-stay acute hospital	1.48	1.45	1.02	0.31
None	−1.13	1.80	−0.63	0.53

(continued)

Table 8-15 (continued)
Dependent variable = mobility change, nervous system patients

Variable	Estimate	Standard error	t value	Pr > |t|
Primary medical diagnosis groups[2]				
Neurologic, stroke	0.65	0.80	0.81	0.42
Neurologic, surgical	−0.23	0.87	−0.27	0.79
Neurologic, medical (referent)	—	—	—	—
Comorbid condition categories[3]				
Cellulitis (HCC120,164)	0.46	2.90	0.16	0.87
Shock, ischemic heart disease, vascular (HCC84,86,87,106,107,108)	−0.08	0.90	−0.09	0.93
Metabolic, diabetes, other endocrine (HCC21,23,24,17,18,19,20,26)	−0.23	0.67	−0.34	0.73
Liver, other GI (HCC27,28,30,29,31,32,33,34,35)	−0.98	0.71	−1.38	0.17
Head and spine injury (HCC166,167,70,71,72)	3.22	1.61	2.00	0.05
Morbid obesity (HCC22)	−0.42	1.43	−0.30	0.77
Orthopedic infection, rheumatoid arthritis, severe skeletal, musculoskeletal, amputation (HCC39,40,41,42,43,44,45,189)	0.41	0.57	0.72	0.48
Polyneuropathy, seizure, other neurological (HCC75,79,73,74,76,77,78)	−1.70	0.65	−2.62	0.01
Psychiatric/depression (HCC54,57,58,59,60,55,56)	−0.44	0.82	−0.53	0.60
Acute and chronic renal (HCC135,136,137,138)	−1.19	1.29	−0.92	0.36
Pneumonia, pleural effusion, other respiratory (HCC114,115,116,117,110,111,112)	0.42	0.93	0.45	0.66
Stroke (HCC99,100,101,102,103,104)	−1.28	0.84	−1.52	0.13
UTI (HCC141,144)	−1.49	0.85	−1.75	0.08
Major treatments				
Hemodialysis	−2.66	1.98	−1.34	0.18
Ventilator (weaning or non-weaning)	7.80	5.49	1.42	0.16
Severe pressure ulcer present[4]				
Yes	−7.04	1.88	−3.75	0.0003
No (referent)	—	—	—	—
Turning surfaces—at least one not intact				
Yes	−1.53	1.12	−1.36	0.18
No	—	—	—	—

(continued)

Table 8-15 (continued)
Dependent variable = mobility change, nervous system patients

Variable	Estimate	Standard error	t value	Pr > |t|
Cognitive status (BIMS)[5]				
Severe cognitive impairment	−0.60	0.96	−0.63	0.53
Prior functioning[6]				
Self-care function: Dependent	−3.90	2.43	−1.60	0.11
Mobility (ambulation): Dependent	−3.95	2.07	−1.91	0.06
Mobility (wheelchair): Dependent or need some help	−2.61	0.89	−2.93	0.004
Bowel: Assistance needed with device				
Yes	−2.54	0.86	−2.93	0.004
Bladder: Indwelling or external device used				
Yes	−0.95	0.77	−1.22	0.22
Swallowing[7]				
Signs and symptoms of disorder present	−0.17	0.83	−0.21	0.84
Swallowing: NPO—intake not by mouth	−2.84	1.44	−1.97	0.05
No (referent)	—	—	—	—
Expression of ideas and wants				
Without difficulty	1.64	0.63	2.59	0.01
With any difficulty or unable to assess (referent)	—	—	—	—
Ability to see in adequate light				
Severely impaired	−0.70	2.21	−0.32	0.75
Not severely impaired (referent)	—	—	—	—
Unable to assess, unknown, missing	3.83	1.47	2.60	0.01
Ability to hear				
Severely impaired	−0.42	1.79	−0.23	0.82
Not severely impaired (referent)	—	—	—	—
Unable to assess, unknown, missing	−5.68	2.45	−2.32	0.02
Respiratory status[8]				
Impaired	−0.79	0.86	−0.92	0.36
Sitting endurance[9]				
No, could not do	−1.82	1.57	−1.16	0.25
Yes, can do with support	−2.42	0.78	−3.10	0.003
Yes, can do without support (referent)	—	—	—	—
Not assessed due to medical restriction	−7.23	1.94	−3.73	0.0003
Depression present[10]				
Yes	−0.62	1.07	−0.58	0.56
No (referent)	—	—	—	—
No interview, comatose or missing	−1.39	0.87	−1.60	0.11

(continued)

Table 8-15 (continued)
Dependent variable = mobility change, nervous system patients

Variable	Estimate	Standard error	t value	Pr > |t|
Function scores[11]				
Independence in mobility at admission	−0.28	0.04	−8.10	<.0001

1 Patients may have received services from more than one provider type in the 2 months prior to the CARE admission. There is no referent group because the item was "Check All that Apply." Hospice and psychiatric hospitals were excluded because of small sample size.

2 Primary diagnosis is determined based on the MS-DRG reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the PAC claim was grouped into an MS-DRG.

3 Comorbidities are based on the diagnoses listed on the CARE admission assessment.

4 Severe pressure ulcers are defined as presence of any stage 3, 4, or unstageable pressure ulcer, or a stage 2 pressure ulcer that has been present for more than 2 months.

5 Patients are considered to be severely cognitively impaired if they received a score of less than 8 on the Brief Interview for Mental Status (BIMS). Patients who did not receive an interview and who were only able to recall one item, or who could recall only two but could not recall that they were "in a hospital, nursing home, or home" on the observational assessment of cognitive status were also considered to be severely cognitively impaired. Patients who scored from 8 to 12 on the BIMS or who could recall two items on the observational assessment including that they were "in a hospital, nursing home, or home" were considered moderately impaired.

6 Prior functioning: Clinicians reported on the patient's usual ability prior to the current illness, exacerbation, or injury. Self-care includes bathing, dressing, using the toilet, and eating. Mobility (ambulation) includes walking from room to room with or without devices such as cane, crutch, or walker. Mobility (wheelchair) includes moving from room to room using a wheelchair, scooter, or other wheeled mobility device. Patients were classified as "independent," "needed partial assistance," or "dependent" on these items. Patients were considered independent if they completed the activities by themselves, with or without an assistive device, with no assistance from a helper. Patients were considered dependent if a helper completed the activity for the patient.

7 Patients are considered to have symptoms of a possible swallowing disorder if the assessment was marked as "Coughing or choking during meals or when swallowing medications," "Holding food in mouth/cheeks or residual food in mouth after meals," or "Loss of liquids/solids from mouth when eating or drinking."

8 Patients are considered to have impaired respiratory status where respiratory status was evaluated while the patient was using supplemental oxygen, and, for patients where status was only reported for activity without supplemental oxygen, if the patient was dyspneic or noticeably short of breath with minimal or less exertion. Patients on ventilators are included in a separate category.

9 Patients were evaluated on their ability to tolerate sitting for 15 minutes to determine sitting endurance.

10 Patients were considered depressed if they reported being sad "often" or "always" in the 2 weeks prior to the assessment interview. Patients who were unable to respond were grouped with the "comatose, no interview, or missing" category.

11 The function score is a continuous measure of a patient's independence in function, with a range from 1 (most dependent) to 100 (most independent).

NOTE: N = 1,755, R-squared = 0.16. BIMS = Brief Interview for Mental Status; CARE = Continuity Assessment Record and Evaluation; FFS = fee-for-service; HCC = hierarchical condition categories; HHA = home health agency; HMO = health maintenance organization; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; NPO = no intake by mouth; SNF = skilled nursing facility; UTI = urinary tract infection.

SOURCE: RTI analysis of Phase 1 CARE assessments and Medicare claims (care_cs223).

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SECTION 9
DETERMINANTS OF RESOURCE INTENSITY: METHODS AND ANALYTIC SAMPLE DESCRIPTION

9.1 Introduction

One important goal of this demonstration is to measure the cost variation across different post-acute settings. The Deficit Reduction Act (DRA) of 2005 called for measuring both the fixed and variable costs of post-acute care (PAC). Standard health care accounting typically divides these costs into direct costs (for components of the provider costs directly related to patient care) and indirect costs (for overhead, capital, and other costs not directly attributable to the care of patients). Alternatively, economists often separate firm costs into variable costs (those that would vary with the number and clinical needs of the patients being treated) versus fixed costs (costs that instead reflect longer-term choices such bed size, areas of clinical focus, and management approach). Although there may be some variable indirect costs and some fixed direct costs, most (roughly 80 percent) indirect costs are assumed to be fixed costs (Noreen and Soderstrom, 1997). Estimates of the relative importance of these two types of costs suggest that fixed costs account for 51 percent of total hospitalization costs and variable costs account for 49 percent (Macario et al., 1995). However, because of the lower capital intensity for skilled nursing facilities (SNFs) (less need for medical equipment, for example) and especially for home health agencies (HHAs), the indirect (and fixed) cost percentages for PAC providers presumably are lower. This report focuses primarily on the variable costs of providing care to these PAC patients, because this is the most difficult component to cull from the cost report data, yet the variable patient-level costs are the basis for any case-mix adjustment system used in a prospective payment system (PPS).

Variable costs per patient are those factors that vary by patient complexity and related factors specific to the individual patient. Variable costs include staff time associated with caring for different types of patients, but it can be difficult to measure these costs in a consistent way across settings. Existing administrative data sources cannot be used to specify patient-specific costs because (1) in general, nurses' and many other direct care providers' time cannot be decomposed on the Medicare cost reports to patient-specific costs, and (2) differences in average routine resource use between Medicare fee-for-service (FFS) and non-Medicare FFS patients are not reported. In addition, charges for therapist services reported on claims may not measure actual relative differences in therapy resource costs among patients. To measure patient-specific costs, we collected cost and resource utilization (CRU) data, or staff-time data, for patients in this study. To collect these data, we developed pencil-and-paper data collection instruments, which were completed by each staff person engaged in direct patient care in the participating provider units. The analyses presented are based on data collected as of April 30, 2010.

Understanding the cost components that explain patient case mix is critical to considering the potential for more consistent payment incentives across PAC PPSs. Much of the past research in this area is related to designing payment policies for an individual type of provider, such as inpatient rehabilitation facilities (IRFs), long-term care hospitals (LTCHs), SNFs, or HHAs. Each of these providers has moved from cost-based reimbursement to a PPS during the past 10 years. Under the newer PPSs, providers are encouraged to manage resources and simultaneously achieve desired outcomes. The paucity of available literature examining costs across PAC provider settings indicates a need for further research.

The elements collected in the Continuity Assessment Record and Evaluation (CARE) tool include proven predictors of health care costs and utilization that have been included in current PAC prospective payment systems, at least for IRFs, SNFs, and HHAs. The CARE data allow for standardized cross-site examination of the patient characteristics that predict costs and utilization. The CRU staff-time data allow measures of staffing costs associated with the patient characteristics found in the CARE data. Together, these two data sources are used to predict staff resource intensity, measured as the resource intensity index (RII), either in routine nursing resources or therapy resources.

This section and the two that follow it present the resource intensity results, which describe the variation in staff intensity across settings. Sections 10 and 11 provide the detailed results. In this section, the analytic methods used for this analysis are presented, including the development of the resource intensity measures. Two resource intensity measures were developed: one for routine care, such as nursing and other nontherapy care, and one for therapy care, including physical therapy, occupational therapy, and speech pathology. This section also includes a description of the analytic sample, which provides an analysis of how patients differ by various characteristics from setting to setting. It also includes an analysis of how routine and therapy resource intensity vary by patient characteristics and by setting. The chapter concludes with a brief discussion of the results of our earlier analyses presented in the May 2011 Contractor Appendix to the Post-Acute Care Payment Reform Demonstration (PAC-PRD) Report to Congress.

9.2 Resource Intensity Analysis Methods

Staff-time studies are important for measuring cost variations associated with types of staff, licensure levels, and total time spent with individual patients and how these factors vary by patient characteristics. With the exception of HHAs, data on staff time with specific patients are not collected regularly by CMS. Although therapy staff in inpatient settings often report patient billing time to their employers, these data are not submitted to CMS and may be recorded inconsistently in claims-based charge codes. Furthermore, no comparable data exist for nontherapy staff time associated with each patient. As a result, collecting primary data on staff time with individual Medicare patients was necessary for creating patient-specific resource intensity measures.

9.2.1 Resource Intensity Sample Definition

The resource intensity sample included all cases with CRU data and matching CARE assessment data (see Section 4). The sample used in this section differs from that used in the outcomes sections in that CRU collection or a home health claim must have occurred during the patient's PAC stay. In total, our resource intensity sample included 6,705 admissions and 79,715 observed patient-days across all settings.

The full sample consisted of two subsamples: home health admissions and PAC inpatient admissions where inpatient refers to IRF, LTCH, and SNF settings. The HHA subsample was created by matching the HHA CARE tool data to Medicare HHA claims by Medicare health insurance claim (HIC) number, resulting in 4,631 HHA episodes. So that the definition of the sample for the resource intensity analysis is as consistent with the definitions of the sample for the other analytic sections (outcomes and discharge destinations), only patients with a finalized admission CARE tool assessment and a matching discharge or expired CARE tool assessment were included. The final HHA sample consisted of 4,071 HHA episodes and a total of 58,123 patient days.[12] If a person had more than one PAC admission with both an admission and discharge assessment, both PAC stays could be in the sample. The inpatient PAC setting subsample (IRF, LTCH, SNF) consisted of patients with matched CARE tool, claims, and CRU data. After processing the CRU data, the inpatient sample consisted of 3,853 patients (1,463 in IRFs, 1,065 in LTCHs, and 1,325 in SNFs). We then subset these patients to those with matching CARE tools and claims data and excluded multiple admission or discharge assessments. After excluding patient-days where CRU data were reported outside of a patient's stay, the final sample consisted of 2,634 patients (1,106 in IRFs, 728 in LTCHs, and 800 in SNFs). The number of inpatient setting days with direct observation of resource intensity was 21,592 (8,256 in IRFs, 6,645 in LTCHs, and 6,691 in SNFs).

9.2.2 Measuring Resource Intensity

The basic measure of resource use is the weighted sum of total staff time per individual patient. Total staff time is based on all direct care staff and support staff directly involved in the care of specific patients. The weights are national average wages for each person's occupation and licensure level. This is effectively a measure of the summed labor-related portion of direct care costs, ignoring fringe benefits.

Because the existing PAC payment systems have different units of payment (60-day episodes for HHAs, discharges for IRFs and LTCHs, and days for SNFs), we originally estimated models of both routine/nursing and therapy resource intensity at two levels of aggregation: day and stay. For the purposes of this project, a home health visit is treated as a "day" and a 60-day home health episode is treated as a "stay." The HHA sample used in this analysis includes only the episodes with CARE assessment information at the start of the episode. Thus, if a patient had an uninterrupted string of HHA episodes within a participating agency, only the first episode would be represented in the sample.

The focus in this section is on models of total resource intensity in a stay in an inpatient PAC setting or an HHA episode in order to identify and compare case-mix characteristics that are associated with higher or lower total resources and that could be associated with higher or lower total Medicare payments. For the purposes of this report, "inpatient PAC stay/home health episode" refers to analyses associated with a single stay (admission to discharge) in an IRF, LTCH, or SNF or a single 60-day episode in an HHA.

9.2.2.1 Constructing the Day/Visit-Level Resource Intensity Measures

The fundamental unit of data collection is the total time per shift that an individual staff person spent with an individual patient on a specific day. Total staff time is summed for each

[12] The number of HHA visits is slightly more than 58,123 because multiple visits can occur on the same calendar day.

individual patient across all staff forms to create a total staff time per patient-day. For staff times associated with more than one patient, times were divided and allocated to individual patients. For example, therapy staff time may be reported in individual sessions or in sessions with two or more patients (e.g., groups or concurrent sessions). When group or concurrent sessions were held, therapy staff time was allocated based on an individual patient's share of time with a staff person. Similarly, some nursing time, such as team meetings, may not be specific to individual patients and was allocated equally across all participating patients.

To convert staff time into resource use, we multiplied the staff time by a national average wage for that occupation to standardize across providers in our sample. We used wages from the Bureau of Labor Statistics (BLS) National Occupational Employment and Wage Estimates survey from May 2008. The BLS survey provides wage estimates for detailed occupations (e.g., physical therapists distinct from occupational therapists, physical therapy assistants distinct from occupational therapy assistants).

We then computed the total resource intensity for each patient-day in the sample by summing the product of time (in hours) and the wage for the occupation category, then summing these time "costs" for each patient-day. The total resource intensity measure is, therefore, proportional to the direct labor cost of providing care to each patient on each observed CRU day.

Two types of RIIs were constructed:

- **Routine Resource Intensity Index (routine RII).** Intensity of care provided by routine staff: nursing, nursing aides, respiratory therapy, social work, and case management.

- **Therapy Resource Intensity Index (therapy RII).** Intensity of care provided by therapy staff: physical therapy, occupational therapy, and speech/language pathology licensed therapists, therapy assistants, and therapy aides.

For each patient-day, we computed the RII by dividing the total resource intensity measure (direct labor cost) for a particular patient-day by the average direct labor cost among all days in our sample, weighting by national proportions of days in that PAC setting—61.7 percent for HHAs, 2.7 percent for IRFs, 2.1 percent for LTCHs, and 33.6 percent for SNFs. This denominator allows the resource intensity measures to be representative of the national PAC population rather than this particular sample. The weights were computed using 2008 Medicare claims. It should be noted that these weights were used only in the construction of the RIIs and not in the multivariate analyses that follow.

Resource intensity for HHA patient-days was computed in a different, but analogous, manner. Rather than use primary data for HHA resource intensity, claims data were used. This is possible because each HHA patient encounter is billed as a separate visit. As for the inpatient RII measures constructed using primary data, each type of home care staff was assigned the national average wage, and all visits occurring on a single calendar day were combined to produce a single patient-day. Note that, unlike for inpatient PAC settings, there will be calendar days during a patient "stay" (60-day HHA episode) for which there is no routine resource intensity because services may not be provided on each day of the episode. The reader should keep in mind that in the analyses that follow in Sections 9 through 11 only the first 60-day HHA episode was examined.

9.2.2.2 Constructing the Stay/Episode-Level Resource Intensity Measures

In addition to predicting resource intensity at the patient-day level, we created models for predicting resource intensity over an entire inpatient PAC stay. Ideally, if all days of a patient's stay have observed CRU data, the daily RIIs could be summed to arrive at a total RII for the stay. With the exception of HHA episodes, for which the claims data provide a complete episode, it is most often the case that there are days without observed CRU data because CRU data were only collected during three 2-week periods over the course of the study. To estimate the total patient-level RIIs for inpatient PAC settings, we combined the observed RIIs from CRU days in the sample with estimates of the RIIs for "missing" days for similar patients for whom CRU data were collected. We estimated the RIIs for "missing" days with setting-specific statistical models of the RII measure on a particular day as a function of the following:

- Combinations of day of stay/episode and length of stay (LOS)/episode: Days and LOS grouped into 1–3, 4–7, 8–15, 16–30, 31–45, 46–60, and 60+ days.
- Combinations (main effects and interactions) of day of stay/episode and five condition groups: Recent stroke, recent hip/knee replacement or fracture, recent acute exacerbation of heart failure, severe respiratory conditions, and other conditions.
- Age: Under 65 years, 65-74 years, 75-84 years, and 85 years or over.
- Smooth functions[13] of the self-care, mobility, and instrumental activities of daily living (IADL) function scales.
- Each patient's own average observed routine and therapy resource intensity from the available CRU data for that person.

These characteristics were selected to be associated with resource intensity while minimizing potential overlap with the explanatory variables intended for the case-mix models. Using these models, we computed predicted values for each day/patient's stay for which no CRU data were observed. We then summed the measured RIIs for patient-days in the CRU sample with the predicted RIIs for days not in the sample to create an estimated total RII for each patient. This process was used to estimate time for missing days rather than assume equal intensity over the course of the stay because intensity is likely to change during the stay.

9.2.3 Analytic Approaches

To investigate the determinants of the routine RII and therapy RII across settings, we conducted a number of multivariate analyses. These analyses included the estimation of generalized linear models (GLM) and the use of classification and regression tree (CART)

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[13] Specifically, the smooth functions are cubic splines, and the model is estimated as a generalized additive model (see Hastie and Tibshirani, 1993).

analyses to supplement the GLM estimations. In this section, we describe the methods used in conducting these analyses. The section starts with a description of the type of resource intensity models that were estimated.

9.2.3.1 Models Estimated

Three types of resource intensity models were initially estimated and reported in the May 2011 Supplement to the Report to Congress:

- **All-PAC Settings.** This type of model estimates a single set of case-mix weights and a single base resource intensity amount for all PAC settings (HHA, IRF, LTCH, and SNF). This model predicts the intensity and amount of care for a given patient, forcing the effects of the patient characteristics on intensity to be uniform across all settings.

- **HHA–Inpatient PAC Settings.** This pair of models is the same as the previous model, but it separates HHAs from inpatient PAC settings on the observation that home health resource intensity structures are significantly different based on the fewer hours of services being provided in the home. This type of model allows the effects of patient characteristics on intensity in the HHA setting to be different from the effects of patient characteristics in the remaining settings. The effects of the patient characteristics on intensity are forced to be uniform across three inpatient settings (IRF, LTCH, and SNF).

- **Setting Specific.** This set of models allows each PAC setting to have its own set of case-mix weights and base resource intensity amount. The Setting-Specific models use consistent measures of patient acuity for each of the different settings, but this model is different from the other two models in that it allows the significance and impact of each measure to differ by setting.

Note that each of the types of models described above is intended to predict resource intensity in all PAC settings. The differences among the model types are in the number and setting-specificity of the submodels that underlie the full model.

9.2.3.2 GLM Estimation

In all cases, the model was specified as a GLM with a logarithmic link and Gaussian error distribution (McCullagh and Nelder, 1989). This type of model specifies that the natural logarithm of the expected value of the RII measure, conditional on all case-mix characteristics, is a linear function of the covariates. This type of model accounts for the quite skewed distribution of resource intensity measures (many patients have low resource intensity, but some have very high resource intensity). By using a GLM specification, we avoid the need for “retransformation” that would be necessary with another standard approach, which is the estimation of an ordinary least squares (OLS) model of the natural logarithm of each RII measure (Mullahy, 1998). GLMs have also been shown, in models of health care expenditures, to be less sensitive to outliers than OLS models of log expenditures (Buntin and Zaslavsky, 2004).

Because of the relatively large number of HHA episodes with zero routine or therapy resource intensity, models of these quantities were estimated using so-called two-stage models. The first stage is a logit model of the likelihood that the patient received any routine or therapy services during an HHA episode. The second stage models the level of the RII for those cases where the patient received services (the relevant RII was greater than zero). The full model is the product of the two parts. For the inpatient models, only the second stage of the model is relevant because all stays involved at least some routine or therapy care.

9.2.3.3 Independent Variable Definitions

Please see Section 5 for a discussion of the independent variables tested in these models. Variables selected for testing included patient characteristics predictive of the type of PAC services that the patient would be receiving and also predictive of patient outcomes and resource utilization. Note that the independent variables were measured at each patient's CARE admission, except for the patient's primary medical diagnosis, which came from the Medicare claim corresponding to the acute discharge prior to the CARE admission, and the days since prior acute discharge, which were also based on claims. The CARE assessment offers a rich set of patient medical, cognitive, impairment, and functional items to control for patient variation not available on the hospital claims.

9.2.3.4 Model Performance Measures

The appropriateness of the three resource intensity models described above for use as the basis of a payment system is determined by how well each model fits the observed resource intensity data. There are two principal ways to assess model performance. One is to consider how well the model explains variation in the resource intensity measure. The most basic model assumes, without any other information, that all stays or episodes have the overall average RII. A model that incorporates additional information into its prediction should improve on the simple model by reducing the difference between the simple (or bivariate) prediction and the actual value for all cases. It is in this sense that one measure of how well the model fits the data is how well this variation is explained. The mean square error (MSE)-based R-squared is a measure of how well a model improves the explanatory power beyond the simple mean-only model, and differences in the MSE-based R-squared indicate improvement in explanatory power.

To look at how models fit the observed data for particular subgroups, such as individual settings in the All-PAC Settings model, we had to construct MSE-based R-squared. Consider the case of using results from the All-PAC Settings model to generate an MSE-based R-squared for SNF stays. First, the overall variation of the resource intensity measure around the SNF-specific mean has to be determined. This measure is usually called the total sum of squares (TSS) by statisticians.

Once the TSS is determined, it needs to be compared with the remaining error inherent in using the multivariate model results to predict resource intensity. This measure of remaining error is known as the residual rum of squares (RSS) and can be constructed using the following steps. First, the All-PAC Settings model results are used to predict the value of the resource intensity measure for each SNF observation. Second, the actual value of the resource intensity measure is subtracted from the predicted value; this value is often called the residual. Third, the residual values for each SNF observation are squared. Finally, squared residuals are summed up across all of the SNF observations.

Once the TSS and RSS have been obtained, the MSE-based R-squared can be calculated as follows.

$$\text{MSE-based R-square} = 1 - (\text{RSS}/\text{TSS})$$

In some cases where the fit is particularly bad for a setting, the MSE-based R-squared can be negative, indicating that taking a simple setting-specific sample mean would be preferable to using the current model to predict resource intensity for patients in that setting.

A second way to assess model performance is to determine the degree of bias in the model. To do this, we computed predicted-versus-actual ratios for setting-specific subgroups of the sample. This ratio compares the average predicted RII to the actual RII. If the predicted-versus-actual ratio is above 1.0, the model overpredicts the RII, and if the ratio is below 1.0, the model underpredicts the RII.

9.3 A Description of the Analytic Sample

This section consists of three principal parts. First, the final CRU analysis sample is described with respect to the case-mix characteristics used in the models. Second, a set of descriptive statistics on the routine RII are presented, stratified by setting and key case-mix characteristics. Third, a set of descriptive statistics on the therapy RII are presented, again stratified by setting and case-mix characteristics.

9.3.1 Sample Description

9.3.1.1 Demographic and Administrative Items

Table 9-1 illustrates the extent to which patient ages vary by treatment setting. SNF and HHA patients tended to be older (75 percent and 67 percent, respectively, were 75 years of age or older), while IRF patients tended to be mostly between 65 and 84 years of age (70 percent). The LTCHs had the highest percentage of nonelderly patients (22 percent) and the lowest percentage of patients aged 85 or older (17 percent). At the other end of the continuum, the SNFs had the lowest percentage of nonelderly patients at roughly 7 percent and the highest percentage of patients aged 85 or older at 38 percent.

Hospital use in the 2 months prior to the PAC admission also varied by treatment setting. The variation is driven by differences between the HHA and inpatient settings. At least 93 percent of all cases in the inpatient settings (IRF, LTCH, SNF) had a hospital admission in the 2 months prior to their PAC admission. However, only 67 percent of the HHA patients were hospitalized in the prior 2 months.

As far as days in the ICU are concerned, patients admitted to LTCHs are quite different from their counterparts in the other PAC settings. One hundred of the 101 patients who had a hospital ICU stay were LTCH patients. Of these patients, 68 had an ICU stay of more than 2 weeks. One patient in the IRF sample had an ICU stay of less than 2 weeks. None of the SNF or HHA patients had an ICU stay prior to PAC admission.

9.3.1.2 Primary Diagnoses and Comorbidities

Table 9-2 lists the primary diagnoses for which patients were admitted to the initial hospitalization in this sample. The results indicate a different mix of patients in each setting. Orthopedic patients were the most common type of case both overall (26 percent) and in most settings (24 percent of the HHA admissions, 35 percent of the IRF admissions, and 42 percent of the SNF admissions). But they make up only 6 percent of all LTCH admissions. Cardiovascular patients were the second most frequent type of case in the CRU sample. Again, the proportion of patients admitted with this type of diagnosis varies considerably across setting, ranging from 19 percent of the HHA admissions to 12 percent of the SNF cases, 10 percent of the IRF cases, and 9 percent of the LTCH admissions. Neurologic cases accounted for 13 percent of all cases, with the majority of the cases being nonsurgical/medical cases (7.2 percent of all admissions in the sample) and stroke cases, which accounted for another 4.8 percent of all admissions. However, stroke cases were the most common specific primary diagnosis group in IRFs (15.6 percent of all IRF admissions in the sample). In fact, neurological cases account for nearly 28 percent of IRF admissions, but no more than 12 percent of admissions to any of the other settings. Respiratory cases accounted for 12.9 percent of cases across all sites of care. However, they were disproportionately represented in LTCHs, accounting for 43.4 percent of all LTCH cases but only about 10 percent of the HHA and SNF cases and about 7 percent of IRF cases.

Another item to note is that a significant number of the primary diagnoses have very low frequencies, especially when considering individual settings. Of the 35 primary diagnoses, 15 have a frequency of 11 or less among LTCH patients, 15 have a frequency of 11 or less among SNF patients, and 16 have such a low frequency among IRF patients. Such low frequencies may make it difficult to make inferences regarding the impact of these particular diagnoses on resource intensity, especially at the individual-setting level.

Table 9-3 describes the types of comorbid conditions found in patients in this sample. Overall, the most common conditions were metabolic, diabetes, and other endocrine conditions (41.2 percent of all cases had a comorbidity in this group). The second most common comorbidity group in these PAC populations was serious orthopedic conditions: bone and joint infections, arthritis, and related conditions (39.8 percent of all cases had a comorbidity in this group). These severe orthopedic comorbidities were present in 57 percent of the IRF cases, 42 percent of SNF cases, 36 percent of HHA cases, and 33 percent of LTCH cases in the sample. Liver and other gastrointestinal (GI) conditions were the third largest group, accounting for over 40 percent of cases in IRFs and LTCHs, 34 percent in SNFs, and 18 percent of the HHA cases. Respiratory conditions, including pneumonia, were another set of common comorbid conditions, present in 48 percent of the LTCH cases, about 15 to 16 percent of the HHA and SNF cases, and 22 percent of the IRF cases. Stroke as a secondary condition was also quite common, especially among the IRF patients. Twenty percent of the IRF admissions had a comorbidity of stroke, compared with 7 to 8 percent of the LTCH and SNF cases, and 3.5 percent of the HHA cases.

9.3.1.3 Major Medical Treatments, Pressure Ulcers, and Major Wounds

Table 9-4 shows how major medical treatments varied by setting. Five major treatments are considered: total parenteral nutrition (use of a feeding tube), central line management, hemodialysis, ventilator therapy, and bowel catheter use. The HHA, IRF, and SNF patients were all extremely unlikely to receive any of these treatments. The greatest prevalence is for central line management among IRF patients at 7.1 percent. Central line management is quite common for LTCH patients, however; roughly two-thirds of them received the treatment. Ventilator use was also very common among LTCH patients, as nearly one-quarter of them were on a respirator at some point during the first 2 days of their stay. The other three treatments were less common among LTCH patients, but these patients were still much more likely to receive these treatments than their counterparts in other settings.

Table 9-4 also shows how the prevalence of skin integrity complications, such as pressure ulcers and wounds, varied by setting. Overall, relatively few (about 5 percent) patients had severe pressure ulcers. However, these severe pressure ulcers were quite common in the LTCH admissions, where 19.4 percent of patients had them. In the other three settings, fewer than 4 percent of the patients had such severe pressure ulcers. Similarly, major wounds were present in about 10 percent of the cases overall, but this ranged from 25 percent of LTCH patients to 5.3 percent of SNF cases.

9.3.1.4 Cognitive Status and Depression

Table 9-5 shows how cognitive status and the prevalence of depression varied across patients in the four different settings.[14] HHA and SNF patients were more likely to have all their cognitive abilities intact or borderline (66.2 percent and 64.6 percent, respectively). LTCH populations had the highest proportion of patients who were severely impaired as 36.3 percent of these patients fell into this category. None of the other settings had more than 18.5 percent of their patients in this category. Overall, HHA patients had the fewest problems with regard to cognitive status, followed by SNF and IRF patients. The LTCH patients had the most problems.

Depression was another common factor, with approximately 7 to 9 percent of the cases in each setting answering that they felt sad often or always. There are a significant number of missing values for this variable, however, because many patients were either comatose or unable to respond upon admission. This was especially true among LTCH patients because more than half fell into this category.

9.3.1.5 Impairments

Table 9-6 illustrates how the prevalence of impairments at admission varied markedly across settings. Bladder incontinence was most prevalent among HHA patients; roughly one-quarter of them had this impairment. Among the other three settings, the prevalence of bladder incontinence ranged from 15.7 percent among LTCH patients to 18.9 percent among SNF patients. Bowel incontinence was much more common among LTCH patients than among patients in the other settings. Forty-one percent of the LTCH patients had this impairment. The

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[14] These estimates include patients who could not be interviewed but whose cognitive status was based on clinical observation.

prevalence of bowel incontinence was similar among SNF and IRF patients (13.8 percent and 12.2 percent, respectively) and much lower for HHA patients (5.6 percent).

The most severe swallowing impairment, NPO or no intake by mouth, was most common in LTCHs (37.2 percent), followed by IRFs (3.4 percent). Swallowing impairments other than NPO (e.g., coughing and choking) were present in a smaller percentage of the patients (10 percent of IRF admissions and roughly 4 to 5 percent in the other settings).

Severe difficulty expressing oneself (rarely or never expressing one's ideas and wants or having speech that is difficult to understand) was most commonly reported for LTCH cases (6.3 percent). Frequent difficulty expressing oneself was common in another 8.4 percent of LTCH admissions and also among patients in SNFs (6.3 percent) and IRFs (6.9 percent), but to a somewhat lesser extent among HHA patients (4.8 percent).

Sitting endurance also varied across PAC settings. Again, the LTCH populations were most likely to have difficulty sitting up without support for 15 minutes; only 21.6 percent could sit without rest. At the same time, nearly one-third (30.1 percent) of the LTCH patients could not sit up for 15 minutes, even with support. About half of all IRF cases could sit with support for 15 minutes, and slightly less in the HHA (41.1 percent) and SNF populations (39 percent).

Having a positive response on the screener question for any signs of respiratory impairment was most common among the LTCH patients (29.3 percent) and least common among the SNF and IRF patients (19.4 and 18.8 percent, respectively).

9.3.1.6 Function and Comorbidity Scores

Table 9-7 illustrates how various measures of function and health vary across the settings. Low values of the Rasch scores indicate lower levels of functional ability, and higher values indicate higher levels of functional ability. The comorbidity index measures the general health of a patient based on his or her comorbidities. Lower values indicate fewer health problems and higher values indicate more health problems.

The results presented in **Table 9-7** have a common theme. A greater proportion of LTCH patients than patients in the other settings has the most severe problems, based on both their functional ability and the presence of comorbidities. Their average Rasch scores are all significantly lower than those of the patients in the other settings and their average comorbidity index score is significantly higher. HHAs have the greatest proportion of patients with the least severe problems. The SNF and IRF patients are firmly in the middle. They are quite similar when it comes to overall functional status, while the IRF patients appear to have more severe chronic health problems than the SNF patients.

9.3.2 Mean Routine RII

9.3.2.1 Overall Summary Statistics

Table 9-8 shows the mean unadjusted resource intensity per stay for the routine RII (nursing and other nontherapy), denominated in registered nurse (RN)-equivalent hours.[15] By definition, inpatient PAC stays (and days) were required to have some amount of routine care time. There may be HHA patients, however, who only receive nursing or therapy services and, therefore, may not have a routine measure for their HHA episode.

Resource intensity differed in expected ways; LTCHs had the highest routine resource intensity per stay, with about 3 times the staff resources of that in IRFs or SNFs (161.4 RN-equivalent hours, compared with 58.6 and 50.9 RN-equivalent hours, respectively). HHAs had the lowest average nursing resource intensity patients. The mean routine intensity was 5.3 hours in all HHA episodes, which is an order of magnitude lower than mean routine intensity in the SNFs and IRFs. When episodes were restricted to the 87.4 percent of HHA episodes that had routine services, the mean routine RII for home health was 6 RN-equivalent hours per 60-day home health episode.

The variation in routine resource intensity also differed by setting. Although HHAs had the smallest standard deviation in the routine RII, the standard deviation was, in fact, the largest relative to the mean, as measured by the coefficient of variation (CV; the ratio of the standard deviation to the mean). The CV for the HHA routine RII was 1.38 (7.3 ÷ 5.3). In contrast, IRFs had the smallest CV (0.73), followed by SNFs (0.84) and then LTCHs (0.92). In other words, a model of routine resource intensity would have more variation across patients to explain for HHAs than for individual inpatient settings.

The total routine RII over a stay was determined by the length of the stay as well as the intensity (average resource intensity per day). For example, IRFs and SNFs had relatively comparable average routine RIIs over an entire stay. However, the average length of an IRF stay (16.9 days) was about half that of an SNF stay (33.3 days). SNFs' average routine daily intensity was therefore less than half that of IRFs' routine daily intensity.

Table 9-8 also provides information on the median and other percentiles for the routine RII by setting. In each setting, the mean exceeds the median, indicating that the distribution of the routine RII is skewed toward higher values within the setting.

9.3.2.2 The Routine RII by Setting and Age and Admission Items

Table 9-9 gives the mean of the routine RII by setting for age groups as well as whether a patient had an acute hospital stay in the 2 months prior to their index hospital admission or time in an ICU prior to the current stay. Regardless of age or prior acute care utilization, the average

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[15] RN-equivalent hours expresses routine resource intensity as the number of hours of care from an RN wage-weighted staffing cost for a particular patient and day. This is calculated by multiplying the hours allocated to a patient-day for each occupation, multiplying by the national average wage for that occupation, summing over occupations for each patient day (to compute a wage cost), then dividing by the national average RN wage. A licensed therapist-equivalent hours adjustment was computed analogously for therapy resource intensity.

routine RII for the LTCH patients is always much higher than the average for either the SNF or IRF patients; in fact, it was usually more than twice as high. Likewise, the average routine RII for the HHA patients is always an order of magnitude lower than the averages for IRF and SNF patients.

Without controlling for other factors, the routine RII generally falls with age for IRF patients; older SNF patients (those at least 85 years of age) have higher routine resource intensity (mean RII of 56.7). LTCH and SNF patients with an acute stay in the 2 months prior to their PAC admission had a greater routine RII than did patients without such a stay. The opposite was true for the IRF patients. Also, the results indicate a positive relationship between ICU stays (and length of ICU stays) and the routine RII. However, ICU stay is only relevant for LTCH patients.

9.3.2.3 The Routine RII by Setting and Primary Condition

On average, LTCHs had the highest routine RII and HHAs had the lowest routine RII, although these varied by condition, as shown in **Table 9-10**. Ventilator cases had the highest routine RII across settings, although the level varied by setting. LTCH cases had over twice as much intensity as the IRF ventilator patients (245.8 RN-equivalent hours in LTCHs compared with 111 for IRFs). Stroke cases, which were common in three of the four settings, varied from 70.4 RN-equivalent hours in the IRFs followed by 66.7 hours in the SNFs, and 4.4 hours in HHAs. Note that these differences in the RII across settings, even for patients with the same primary condition, may reflect differences in other case-mix characteristics across settings.

9.3.2.4 The Routine RII by Setting and Comorbid Condition

Table 9-11 gives the mean routine RII by setting and comorbid condition. In general, having a comorbid condition tends to increase the total routine resource intensity a patient receives over the course of a PAC stay/episode. In particular, morbid obesity, head and spine injury, acute and chronic renal failure, cellulitis, and urinary tract infections are most highly associated with higher levels of the routine RII, conditional on setting. Note, again, that the level of the routine RII is considerably higher for LTCH patients and considerably lower for HHA patients regardless of comorbidity.

9.3.2.5 The Routine RII by Setting and Other Medical Items

Table 9-12 gives the mean routine RII by utilization of selected major treatments, presence of pressure ulcers, and presence of major wounds. In general, if a patient receives a major treatment, their routine RII is higher. The exception is for hemodialysis in the IRFs, where it appears to have no impact on the value of the routine RII. Note that the average total routine RII is much greater for some major treatments (e.g., parenteral nutrition and ventilator use) than others (e.g., hemodialysis), but only LTCHs provide ventilator use with more than a negligible frequency. Generally, the presence of pressure ulcers and major wounds is associated with a higher total stay routine RII, regardless of setting. The effects are substantial with the exception that the presence of a major wound has only a negligible positive impact on the routine RII among IRF patients. Again, regardless of major treatments or wounds, the level of the routine RII is much higher for LTCH patients and considerably lower for HHA patients.

9.3.2.6 The Routine RII by Setting and Cognitive Status

Table 9-13 gives the mean routine RII by the cognitive status and how frequently the patient reports feeling sad. Without controlling for other factors, impaired cognitive status appears to be associated with greater resource intensity. This relationship is strongest for LTCH patients. Depressed patients also tend to have a somewhat higher total stay routine RII, although this overall result does not hold for LTCH patients. Again, regardless of cognitive ability or depressed status, the average routine RIIs are much higher for LTCH patients and much lower for HHA patients.

9.3.2.7 The Routine RII by Setting and Impairments

Table 9-14 gives the mean routine RII by selected impairments. Bladder incontinence is associated with a higher routine RII in IRFs and SNFs, while bowel incontinence is associated with a higher routine RII across all four settings. Except for LTCHs, swallowing symptoms tend to increase the routine RII. The inability to take food or water by mouth increases the routine RII across HHAs, IRFs, and LTCHs. Impairments in communication (expression of ideas and wants) and in sitting endurance generally tend to increase the total stay routine RII, regardless of setting. Respiratory impairments tend to have a positive effect on the total stay routine RII, except for in LTCHs, where the effect is negative.

The relationship between the routine RII and expressive ability is similar across the three inpatient settings: increased expressive ability is related to a lower routine RII in each case. The relationship between sitting endurance and the routine RII is also similar across the three inpatient settings: the routine RII is much higher for patients who cannot sit for 15 minutes than for those who can sit for 15 minutes without support. Note that regardless of functional impairment, the average routine RII is much higher for LTCH patients and much lower for HHA patients.

9.3.2.8 The Routine RII by Setting and Functional Status

Table 9-15 presents the mean routine RII by quartiles of the Rasch scores and comorbidity index. Again, we find that, on average, LTCH patients are the most resource intensive and HHA patients are the least resource intensive, regardless of functional status or comorbidity level. Within settings, the routine RII generally decreases as the Rasch scores increase. This makes sense, because the higher Rasch scores indicate a better ability to move around or to perform basic self-care tasks. Also, the routine RII generally increases as the comorbidity index increases within settings. Again, this is to be expected because a higher comorbidity index score indicates a greater level of illness, so we would expect patients with higher comorbidity index scores to require more nursing care.

9.3.3 Mean Therapy RII

9.3.3.1 Overall Summary Statistics

Unlike in the case of routine services, patient-days were not required to have therapy-related services in inpatient settings. However, when days were aggregated into stays, all of the inpatient PAC settings (SNF, IRF, and LTCH) had some amount of therapy associated with all stays in this study.[16] Therefore, as shown in **Table 9-16**, the therapy RII was positive for 100 percent of IRF, LTCH, and SNF stays. However, therapy was positive for only 73.8 percent of HHA episodes. The therapy RII for patients varied as expected, with the highest therapy RII in IRFs, with a mean of 47.6 licensed therapist-equivalent hours per stay, and a slightly lower stay-total therapy RII in SNFs, with a mean of 43.9 therapist-equivalent hours per stay. The average stay-total therapy RII for LTCH patients was 33.1 therapist-equivalent hours. In HHAs, the mean therapy RII was 10.1 hours across all episodes and 13.7 hours for episodes that included at least one therapy visit (not shown).

The variation in the therapy RII also differed by setting. SNFs and HHAs exhibited the largest variation in the therapy RII relative to their respective means, as measured by the CV. The CV for the SNF therapy RII was 1.2 and for the HHA therapy RII was 1.1. In contrast, IRFs and LTCHs both had CVs of approximately 0.9. In other words, a model of therapy RII has more variation across patients in HHAs and SNFs than in IRFs and LTCHs.

As is the case for the routine RII, underlying the total therapy RII averages are important relationships between LOS and average therapy RII per day. The SNF total therapy RII is spread out over slightly more than twice as many days on average than in IRFs. Thus, the per diem therapy RII for SNF patients is slightly less than half the per diem therapy RII for IRF patients, despite the fact that the per-stay therapy RII is similar across the two settings.

The frequency of therapy care also varies across settings. On average, IRF patients received therapy on 5.2 days per week (or 74 percent of days), while SNF patients received therapy care on 4.3 days per week (or 62 percent of days). Therapy was provided to LTCH patients on 3.8 days per week (or 55 percent of days) on average. Roughly 52 percent of HHA days included some therapy.

Table 9-16 also provides information on the median and other percentiles for the therapy RII by setting. In each setting, the mean exceeds the median, indicating that the distribution of the therapy RII is skewed toward higher values within the setting.

9.3.3.2 The Therapy RII by Setting and Administrative and Admission Items

Table 9-17 gives the mean therapy RII by setting for age groups as well as whether a patient had an acute hospital stay in the 2 months prior to their PAC admission or time in an ICU prior to the current stay. There is no systematic pattern in the relationship between age and therapy RII when controlling only for setting. The therapy RII falls with age in IRFs and rises with age in HHAs. LTCHs and SNFs exhibit no systematic age trend, although for SNFs, the therapy RII tends to rise with age for the elderly population. Patients in LTCHs and SNFs with an acute stay in the 2 months prior to the current PAC stay had a higher total therapy RII than did patients without such a stay. Also, patients with more than 14 ICU days in the short-stay acute hospital stay prior to their PAC stay had a greater therapy RII than did patients without as many ICU days. However, this is only relevant for LTCH patients.

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[16] This may be due to the incentives in the SNF prospective payment system, which may encourage therapy evaluations for all SNF admissions.

9.3.3.3 The Therapy RII by Setting and Primary Condition

Table 9-18 presents the average total therapy RII for each primary diagnosis group, by setting. The therapy RII was greatest for stroke patients in SNFs (73.8 therapist-equivalent hours), followed closely by IRFs (67.9 hours). For most conditions, SNFs and IRFs had the highest total therapy RII.

9.3.3.4 The Therapy RII by Setting and Comorbid Condition

Table 9-19 gives the mean therapy RII by setting and comorbid condition. In general, some of the comorbid conditions were associated with a higher therapy RII and some were associated with a lower therapy RII. Patients with a comorbidity of stroke had the highest therapy RII in HHAs (16.2 hours), patients with a comorbidity of head and spine injury had the highest therapy RII in IRFs (73 hours), patients with cardiovascular comorbidities had the highest therapy RII in LTCHs (37.5 hours), and patients with a comorbidity of stroke had by far the highest therapy RII in SNFs (74.7 hours).

9.3.3.5 The Therapy RII by Setting and Other Medical Items

Table 9-20 gives the mean therapy RII by utilization of selected major treatments, presence of pressure ulcers, and presence of major wounds. Among HHA patients, those who receive a major treatment have a lower therapy RII than patients who did not receive a major treatment. The relationship between major treatment and the therapy RII is less clear in the inpatient settings. For instance, hemodialysis is associated with a lower therapy RII in IRFs and a higher therapy RII in SNFs, while central line management is associated with a higher therapy RII in IRFs and a lower therapy RII in SNFs. Major treatments are associated with a higher therapy RII in LTCHs, with the exception of hemodialysis, which has the opposite effect.

There are no systematic relationships between the presence of pressure ulcers or of major wounds and the total stay therapy RII across settings. Pressure ulcers are associated with a higher therapy RII in IRFs and SNFs (which are the relatively more therapy-intensive settings) but with a lower therapy RII in HHAs and LTCHs. Major wounds are associated with a higher therapy RII in the inpatient settings but with a lower therapy RII in the HHAs.

9.3.3.6 The Therapy RII by Setting and Cognitive Status

Table 9-21 gives the mean therapy RII by cognitive status and how frequently the patient reports feeling sad. Impaired cognition appears to be associated with a greater therapy RII. However, in HHAs the relationship is not monotonic—in this setting, patients reported as moderately impaired had the highest total therapy RII. Patients reporting feeling sad often or always had a higher total stay therapy RII across all settings.

9.3.3.7 The Therapy RII by Setting and Impairments

Table 9-22 gives the mean total stay therapy RII by selected impairments. Both bladder and bowel incontinence are generally associated with a higher therapy RII in all settings except for the LTCHs, where bladder incontinence is associated with a lower mean therapy RII. The differences tend to be greatest for IRFs and SNFs. Swallowing impairments tend to increase the therapy RII. NPO (no food by mouth allowed) is more strongly associated with a higher therapy RII. Impairments in communication (expression of ideas and wants) and in sitting endurance tend to increase the therapy RII, comparing patients without the impairment to those who have the greatest impairment. Respiratory impairments tend to have a modest positive effect on the therapy RII for IRF and SNF patients. This modest effect is reversed for HHA and LTCH patients.

9.3.3.8 The Therapy RII by Setting and Functional Status

Table 9-23 presents the mean therapy RII by quartiles of the Rasch scores and comorbidity index. Across all settings, the results indicate that greater functionality (higher Rasch scores) is associated with lower levels of the therapy RII. The relationship is weaker for LTCHs especially at the lower Rasch scores. For instance, LTCH patients with Rasch motor scores in the bottom quartile (score less than 40.6) have a lower therapy RII than those with Rasch motor scores in the second quartile (scores between 40.6 and 49.8). Also, in the inpatient PAC settings the therapy RII generally increases as the comorbidity index increases, with the exception of SNFs where the therapy RII is lower for patients in the highest quartile than for patients in the third quartile. Again, this general trend is to be expected because a higher comorbidity index score indicates a greater level of illness, so we would expect patients with higher comorbidity index scores to require more therapy.

9.4 Summary of Previous Multivariate Analyses

The Post-Acute Care Payment Reform Demonstration Report to Congress Supplement-Interim Report from May 2011 included several findings regarding the drivers of the RIIs and therapy RIIs. Although several changes have been made to the multivariate models reported on in the earlier report, we summarize some of the major findings of that earlier work here. Further information about these models and results can be found in Section 6 of the Interim Report.

Overall, the following main points arise from the prior work and feed into the new analyses:

- The development of case-mix systems using uniform definitions and measures of patient acuity between different settings is possible and can be accomplished with a limited set of common patient acuity items.

- PAC payment systems can be improved by including patient acuity measures that are not used in current payment systems.

- PAC payment systems can be improved by separately examining and modeling the routine and therapy aspects of patient-specific resource use.

- Evidence supports the potential for developing a common case-mix adjustment system for the three inpatient PAC settings: IRFs, LTCHs, and SNFs. This system would calculate the patient-specific resource expenditures portion of payment in the same manner across settings.

In Sections 10 and 11 of this report, RTI continues the analysis begun in the Interim Report with further exploratory modeling and refinement of the measures of patient acuity.

9.4.1 Summary of Findings on the Routine RII

A major focus of the analysis in the Interim Report was to examine the possibility of creating a model to predict the routine RII that depends primarily on understanding patient acuity and that does not rely on information regarding the setting of care. The tables in this section, reproduced from the Interim Report, show information on model fit for the three types of models described in Section 9.2.3.1.

- All-PAC Settings model
- HHA-Inpatient PAC Settings model
- Setting-Specific model

In examining the All-PAC Settings model, the R-squared statistics showed that patient acuity measures were important predictors of the routine RII and that setting indicators added slightly more explanatory power (see **Table 9-24**). Notably, the All-PAC Settings model results suggested that payment adjustors for HHAs may need to be based on a significantly lower base rate than for other settings. The very high (3.49) predicted-to-actual ratio for the HHA routine RII indicates that in a model that makes no distinction between settings, HHAs would be overpaid for routine/nursing care by 249 percent ($3.49 \times 100 - 100$) relative to their true resource intensity (see **Table 9-25**). Similarly, IRFs and LTCHs would be underpaid by about 20 percent, and SNFs would be underpaid by 40 percent in an All-PAC Settings model.

When setting and acuity measures were examined in the HHA–Inpatient model, which separates HHAs from the inpatient PAC settings, the R-squared statistics showed that this model was superior to the All-PAC Settings model (see **Table 9-24**). Separating HHAs from the inpatient settings dramatically improved the explanatory power of the models. In the HHA–Inpatient PAC Settings model, comparing the models with and without setting indicators suggested that including an indicator of the type of inpatient PAC would not improve the model's overall explanatory power. When HHAs were separated from the inpatient PAC settings, the predicted-to-actual ratios show that the under- and over-predictions of routine RII are within 10 percent of the actual value. This suggests that it may be possible, using an alternative specification, to construct a payment model that models patient intensity needs uniformly across inpatient PAC settings using a common set of case-mix weights and base resource intensity amount. A separate HHA model could be based on consistent measures of patient acuity but would vary from the inpatient model in both the base rate and the weights assigned to the acuity measures. Therefore, separating HHA from the three inpatient setting models appeared to be a reasonable approach.

The predicted-to-actual ratio patterns suggested that a multisetting model that includes HHAs would be inadvisable (see **Table 9-25**). The nature of the service frequency and type of services provided are sufficiently different that these case-mix characteristics may not be able to explain variation in resource intensity. A multisetting model where patient acuity is measured and weighted uniformly between the three PAC inpatient settings could potentially be developed after adjusting for slight areas of bias. The least biased approach, the Setting-Specific models, improved the consistency of payment systems between the settings by standardizing the acuity measures but not the weights attached to the measures.

9.4.2 Summary of Findings on the Therapy RII

As was the case for routine services, the Interim Report also sought to examine the creation of therapy RII models based on patient acuity measures and that would not rely on information regarding the setting of care. Again, the All-PAC Settings, HHA–Inpatient PAC Settings, and Setting-Specific models were estimated.

In examining the All-PAC Settings model for therapy, the predicted-to-actual ratios for the therapy RII were generally less extreme than those for routine RII (see **Table 9-26**). The high (1.53) predicted-to-actual ratio for the HHA therapy RII indicated that, in a model that makes no distinction between settings, HHAs would be overpaid for therapy care by 53 percent relative to their true resource intensity. Compared with the 249 percent overestimate of the routine RII in the All-PAC Settings model, it seemed the therapy RII for HHAs was more accurately predicted. However, a 53 percent overestimate is still quite significant. IRFs and SNFs would be underpaid by 15 and 38 percent, respectively, using these coefficients. The routine RII for LTCHs is estimated relatively accurately. Therefore, separating HHAs from the three inpatient settings appeared to be an advisable approach for therapy as well as routine services.

When HHAs were separated from inpatient PAC settings in the models, the R-squared statistics indicated again that the HHA–Inpatient PAC Settings model had superior predictive power than the All-PAC Settings model (see **Table 9-27**). When setting and acuity measures were examined in the inpatient-only component of the HHA–Inpatient PAC Settings model, LTCHs were statistically significantly negative compared with SNFs, but IRFs were not significantly different from SNFs. This suggests that a therapy payment model combining the inpatient settings but excluding HHAs may be feasible for IRFs and SNFs, but that the model would need to be modified to better identify LTCHs' lower therapy stay-total. In the HHA–Inpatient PAC Settings model, the under- and over-predictions of the therapy RII would be within 15 percent of the true values (see **Table 9-26**). Using this model, LTCHs would be overpaid for therapy services by 15 percent and SNFs would be underpaid by 11 percent.

Because of the setting's relatively high predicted-to-actual ratio in the HHA-Inpatient PAC Settings model, it was determined that LTCH models of therapy intensity needed further development either as a stand-alone system or combined in an inpatient PAC setting model. As formulated, the Setting-Specific model showed the best fit for therapy. It was concluded that if a slight reduction of fit were tolerable in furtherance of the effort to standardize payment methodologies between settings, a standardized IRF-SNF model was promising and a standardized inpatient PAC model was possible. However, a therapy model that used consistent weights across all four settings did not seem advisable.

Table 9-1
Age and admission information, by provider type, resource intensity sample

Variable name	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Age										
64 years and under	751	11.2	421	10.3	120	10.8	158	21.7	52	6.5
65-69 years	762	11.4	406	10.0	164	14.8	132	18.1	60	7.5
70-74 years	918	13.7	534	13.1	183	16.5	110	15.1	91	11.4
75-79 years	1,181	17.6	741	18.2	200	18.1	105	14.4	135	16.9
80-84 years	1,265	18.9	786	19.3	221	20.0	101	13.9	157	19.6
85 years and above	1,828	27.3	1,183	29.1	218	19.7	122	16.8	305	38.1
Total	6,705	100.0	4,071	100.0	1,106	100.0	728	100.0	800	100.0
Gender										
Male	2,479	37.0	1,437	35.3	479	43.3	340	46.7	223	27.9
Female	4,226	63.0	2,634	64.7	627	56.7	388	53.3	577	72.1
Total	6,705	100.0	4,071	100.0	1,106	100.0	728	100.0	800	100.0
Acute claim within the past 2 months										
Yes	5,259	78.4	2,738	67.3	1,033	93.4	703	96.6	785	98.1
No	1,446	21.6	1,333	32.7	73	6.6	25	3.4	15	1.9
Total	6,705	100.0	4,071	100.0	1,106	100.0	728	100.0	800	100.0
ICU stay										
No prior ICU stay	6,604	98.5	4,071	100.0	1,105	99.9	628	86.3	800	100.0
Prior ICU stay of 1 to 14 days	33	0.5	†	†	†	†	32	4.4	†	†
Prior ICU stay of more than 14 days	68	1.0	†	†	†	†	68	9.3	†	†
Total	6,705	100.0	4,071	100.0	1,106	100.0	728	100.0	800	100.0

† Indicates sample size of less than 11.

NOTE: HHA = home health agency; ICU = intensive care unit; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-2
Primary diagnosis groupings, by provider type, resource intensity sample

Primary diagnosis	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Neurologic, stroke	308	4.6	96	2.4	172	15.6	†	†	31	3.9
Neurologic, surgical	101	1.5	26	0.6	63	5.7	†	†	†	†
Neurologic, medical	484	7.2	370	9.1	67	6.1	†	†	36	4.5
Neurologic, total	**893**	**13.3**	**492**	**12.1**	**302**	**27.4**	**27**	**3.7**	**72**	**9.0**
Respiratory, ventilator and tracheostomy	278	4.1	26	0.6	21	1.9	224	30.8	†	†
Respiratory, medical	349	5.2	212	5.2	32	2.9	59	8.1	46	5.8
Respiratory, surgical	64	1	39	1	†	†	†	†	†	†
Respiratory, COPD	174	2.6	115	2.8	†	†	26	3.6	22	2.8
Respiratory, total	**865**	**12.9**	**392**	**9.6**	**73**	**6.6**	**316**	**43.4**	**84**	**10.5**
Orthopedic, minor surgical	398	5.9	169	4.2	117	10.6	22	3.0	90	11.3
Orthopedic, major medical	80	1.2	39	1	23	2.1	†	0.3	16	2.0
Orthopedic, spinal	165	2.5	74	1.8	61	5.5	†	0.8	24	3.0
Orthopedic, minor medical	349	5.2	267	6.6	31	2.8	†	0.5	47	5.9
Orthopedic, major surgical	735	11	422	10.4	149	13.5	†	1.4	154	19.3
Orthopedic, total	**1,727**	**25.8**	**971**	**24.0**	**381**	**34.5**	**44**	**6.0**	**331**	**41.5**
Cardiovascular, vascular surgical	117	1.7	63	1.5	30	2.7	17	2.3	†	†
Cardiovascular, cardiac surgical	295	4.4	207	5.1	42	3.8	23	3.2	23	2.9
Cardiovascular, general	216	3.2	177	4.3	15	1.4	†	†	17	2.1
Cardiovascular, vascular medical	68	1	56	1.4	†	†	†	†	†	†
Cardiovascular, cardiac medical	350	5.2	251	6.2	22	2.0	21	2.9	56	7.0
Integumentary, surgical	62	0.9	32	0.8	†	†	22	3	†	†
Integumentary, medical	239	3.6	181	4.4	†	†	23	3.2	25	3.1
Endocrine, surgical	25	0.4	†	†	†	†	†	†	†	†
Endocrine, medical	175	2.6	128	3.1	15	1.4	†	†	27	3.4

(continued)

Table 9-2 (continued)
Primary diagnosis groupings, by provider type, resource intensity sample

Primary diagnosis	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Kidney and urinary, surgical	24	0.4	16	0.4	†	†	†	†	†	†
Kidney and urinary, medical	235	3.5	166	4.1	25	2.3	17	2.3	27	3.4
Infections, surgical	61	0.9	17	0.4	†	†	32	4.4	†	†
Infections, medical	34	0.5	17	0.4	†	†	†	†	†	†
Infections, septicemia	136	2	59	1.4	16	1.4	42	5.8	19	2.4
Transplant	†	†	†	†	†	†	†	†	†	†
GI and hepatobiliary, minor surgical	79	1.2	54	1.3	†	†	†	†	†	†
GI and hepatobiliary, major surgical	118	1.8	66	1.6	12	1.1	27	3.7	13	1.6
GI and hepatobiliary, minor medical	149	2.2	109	2.7	†	†	17	2.3	14	1.8
GI and hepatobiliary, major medical	126	1.9	87	2.1	†	†	20	2.7	13	1.6
Hematologic, surgical	12	0.2	†	†	†	†	†	†	†	†
Hematologic, medical	62	0.9	48	1.2	†	†	†	†	†	†
Other, surgical	124	1.8	62	1.5	23	2.1	28	3.8	†	†
Other, medical	505	7.5	398	9.8	77	†	†	†	17	2.1
Medical/Surgical, total	**3,220**	**48.0**	**2,216**	**54.4**	**350**	**31.6**	**341**	**46.8**	**313**	**39.1**
Total	**6,705**	**100.0**	**4,071**	**100.0**	**1,106**	**100.0**	**728**	**100.0**	**800**	**100.0**

† Indicates sample size of less than 11.

NOTE: Primary diagnosis is determined based on the MS-DRG reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the PAC claim was grouped into an MS-DRG. COPD = chronic obstructive pulmonary disease; CRU = cost and reduction utilization; GI = gastrointestinal bleeding; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MS-DRG = Medicare Severity-Diagnosis Related Group; PAC = post-acute care; SNF = skilled nursing facility.

SOURCE: RTI International analyses of 2008 to 2010 Medicare claims data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-3
Most common comorbid conditions, by provider type, resource intensity sample

Variable Name	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Hierarchical Condition Category Groups										
Cellulitis (HCC120,164)	173	2.6	50	1.2	41	3.7	73	10.0	†	†
Shock, ischemic heart disease, vascular (HCC84,86,87,106,107,108)	734	10.9	277	6.8	177	16.0	206	28.3	74	9.3
Metabolic, diabetes, other endocrine (HCC21,23,24,17,18,19,20,26)	2,765	41.2	1,333	32.7	582	52.6	544	74.7	306	38.3
Liver, other GI (HCC27,28,30,29,31,32,33,34,35)	1,807	27.0	739	18.2	463	41.9	333	45.7	272	34.0
Head and spine injury (HCC166,167,70,71,72)	157	2.3	44	1.1	62	5.6	44	6.0	†	†
Morbid obesity (HCC22)	184	2.7	51	1.3	44	4.0	78	10.7	†	†
Orthopedic infection, rheumatoid arthritis, severe skeletal, musculoskeletal, amputation (HCC39,40,41,42,43,44,45,189)	2,668	39.8	1,458	35.8	632	57.1	241	33.1	337	42.1
Polyneuropathy, seizure, other neurological (HCC75,79,73,74,76,77,78)	753	11.2	369	9.1	201	18.2	118	16.2	65	8.1
Psychiatric/depression (HCC54,57,58,59,60,55,56)	406	6.1	134	3.3	130	11.8	102	14.0	40	5.0
Acute and chronic renal (HCC135,136,137,138)	450	6.7	150	3.7	110	9.9	158	21.7	32	4.0
Pneumonia, pleural effusion, other respiratory (HCC114,115,116,117,110,111,112	1,339	20.0	617	15.2	247	22.3	350	48.1	125	15.6
Stroke (HCC99,100,101,102,103,104)	478	7.1	142	3.5	223	20.2	57	7.8	56	7.0
UTI (HCC141,144)	709	10.6	133	3.3	300	27.1	203	27.9	73	9.1

† Indicates sample size of less than 11.

NOTE: The comorbid conditions are taken from the secondary diagnoses on the prior acute hospital claim and from all diagnoses on the PAC claims. Patients can have more than one comorbid condition. CRU = cost and resource utilization; HCC = hierarchical condition category; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; SNF = skilled nursing facility; UTI = urinary tract infection.

SOURCE: RTI International analyses of 2008 to 2010 Medicare claims data for the CARE+CRU sample: The set of CARE patients with matched claims and CRU data collection forms.

Table 9-4
Major treatments and pressure ulcer and major wound presence, by provider type, resource intensity sample

Variable name	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Major treatment: total parenteral nutrition	75	1.1	†	†	†	†	67	9.2	†	†
Major treatment: central line management	597	8.9	27	0.7	78	7.1	476	65.4	16	2.0
Major treatment: hemodialysis	164	2.4	51	1.3	22	2.0	75	10.3	16	2.0
Major treatment: ventilator	181	2.7	†	†	†	†	173	23.8	†	†
Major treatment: bowel catheter	43	0.6	†	†	†	†	34	4.7	†	†
Severe pressure ulcer indicator (Stage 3, 4, unstageable or stage 2 > 1 month)										
Severe pressure ulcer present	319	4.8	120	2.9	29	2.6	141	19.4	29	3.6
Severe pressure ulcer not present	6,386	95.2	3,951	97.1	1,077	97.4	587	80.6	771	96.4
Total	6,705	100.0	4,071	100	1,106	100.0	728	100.0	800	100.0
Presence of major wound										
Major wound present	694	10.4	403	9.9	66	6.0	183	25.1	42	5.3
Major wound not present	6,011	89.6	3,668	90.1	1,040	94.0	545	74.9	758	94.8
Total	6,705	100.0	4,071	100.0	1,106	100.0	728	100.0	800	100.0

† Indicates sample size of less than 11.

NOTE: Information in this table comes from the CARE form collected at admission to the PAC setting. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool data for the CARE+CRU sample: The set of CARE patients with matched claims and CRU data collection forms.

Table 9-5
Cognitive status, by provider type, resource intensity sample

Variable name	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Cognitive status[1]										
Cognitive abilities intact or borderline	4,169	62.2	2,693	66.2	651	58.9	308	42.3	517	64.6
Cognitive abilities moderately impaired	1,315	19.6	812	19.9	240	21.7	120	16.5	143	17.9
Cognitive abilities severely impaired	1,133	16.9	528	13.0	205	18.5	264	36.3	136	17.0
No interview, comatose, unable to respond, missing	88	1.3	38	0.9	10	0.9	36	4.9	4	0.5
Total	6,705	100.0	4,071	100.0	1,106	100.0	728	100.0	800	100.0
Depression (feeling sad)[2]										
Not depressed (rarely, never, sometimes)	4,775	71.2	3,136	77.0	724	65.5	277	38.0	638	79.8
Depressed (often, always)	516	7.7	305	7.5	97	8.8	56	7.7	58	7.3
No interview, comatose, unable to respond, missing	1,414	21.1	630	15.5	285	25.8	395	54.3	104	13.0
Total	6,705	100.0	4,071	100.0	1,106	100.1	728	100.0	800	100.1

[1] Cognitive status was assessed through the Brief Interview for Mental Status (BIMS) and an observation assessment for patients who could not be interviewed.

[2] Patients are asked the question “During the past 2 weeks, how often would you say ‘I feel sad’?”

NOTE: Information in this table comes from the CARE form collected at admission to the PAC setting. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-6
Impairments, by provider type, resource intensity sample

Variable name	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Bladder incontinence[1]										
Yes	1,523	22.7	1,061	26.1	197	17.8	114	15.7	151	18.9
No	5,182	77.3	3,010	73.9	909	82.2	614	84.3	649	81.1
Total	6,705	100.0	4,071	100.0	1,106	100.0	728	100.0	800	100.0
Bowel incontinence[1]										
Yes	773	11.5	228	5.6	135	12.2	300	41.2	110	13.8
No	5,932	88.5	3,843	94.4	971	87.8	428	58.8	690	86.3
Total	6,705	100.0	4,071	100.0	1,106	100.0	728	100.0	800	100.0
Swallowing symptoms[2]										
Yes	356	5.3	171	4.2	109	9.9	38	5.2	38	4.8
No	6,349	94.7	3,900	95.8	997	90.1	690	94.8	762	95.3
Total	6,705	100.0	4,071	100.0	1,106	100.0	728	100.0	800	100.0
Swallowing: NPO										
Yes	345	5.1	25	0.6	38	3.4	271	37.2	†	†
No	6,360	94.9	4,046	99.4	1,068	96.6	457	62.8	789	98.6
Total	6,705	100.0	4,071	100.0	1,106	100.0	728	100.0	800	100.0
Expression ideas and wants										
Rarely/never expresses oneself	155	2.3	57	1.4	39	3.5	46	6.3	13	1.6
Frequently has difficulty	382	5.7	195	4.8	76	6.9	61	8.4	50	6.3
Some difficulty	1,310	19.5	829	20.4	243	22.0	143	19.6	95	11.9
Without difficulty	4,701	70.1	2,971	73.0	736	66.5	358	49.2	636	79.5
Unknown	157	2.3	19	0.5	12	1.1	120	16.5	†	†
Total	6,705	100.0	4,071	100.0	1,106	100.0	728	100.0	800	100.0

(continued)

Table 9-6 (continued)
Impairments, by provider type, resource intensity sample

Variable name	Overall n	Overall %	HHA n	HHA %	IRF n	IRF %	LTCH n	LTCH %	SNF n	SNF %
Sitting endurance impairment										
No, could not do	435	6.5	115	2.8	50	4.5	219	30.1	51	6.4
Yes, can do with support	2,762	41.2	1,672	41.1	551	49.8	227	31.2	312	39.0
Yes, can do without support	3,272	48.8	2,227	54.7	482	43.6	157	21.6	406	50.8
Not assessed due to medical restriction	236	3.5	57	1.4	23	2.1	125	17.2	31	3.9
Total	6,705	100.0	4,071	100.0	1,106	100.0	728	100.1	800	100.1
Any respiratory impairment[3]										
Yes	1,515	22.6	939	23.1	208	18.8	213	29.3	155	19.4
No	5,190	77.4	3,132	76.9	898	81.2	515	70.7	645	80.6
Total	6,705	100.0	4,071	100.0	1,106	100.0	728	100.0	800	100.0

† Indicates sample size of less than 11.

[1] A patient is considered incontinent if the assessment was marked as "incontinent daily" or "always incontinent."

[2] A patient is considered to have symptoms of a possible swallowing disorder if the assessment was marked as "coughing or choking during meals or when swallowing medications," "holding food in mouth/cheeks or residual food in mouth after meals," or "loss of liquids/solids from mouth when eating or drinking."

[3] Respiratory impairment is based on the question "does the patient have any impairments with respiratory status?"

NOTE: Information in this table comes from the CARE form collected at admission to the PAC setting. HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; NPO = nothing by mouth; PAC = post-acute care; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-7
Rasch scores and comorbidity index, by provider type, resource intensity sample

Measure/setting	Mean	Std. dev.	5th %tile	25th %tile	50th %tile	75th %tile	95th %tile
Rasch mobility score							
HHA	47.2	17.6	15.0	35.0	49.0	59.0	75.0
IRF	24.1	11.7	7.0	16.0	24.0	31.0	46.0
LTCH	19.1	12.3	4.0	11.0	15.0	26.0	43.0
SNF	26.9	13.7	7.0	17.0	25.0	36.0	52.0
Overall	37.9	19.6	8.0	22.0	37.0	53.0	71.0
Rasch self-care score							
HHA	36.3	9.9	16.0	30.0	38.0	45.0	48.0
IRF	24.2	9.1	8.0	19.0	25.0	31.0	37.0
LTCH	16.9	10.7	5.0	8.0	14.0	24.0	38.0
SNF	26.0	9.2	9.0	21.0	27.0	32.0	39.0
Overall	31.0	12.0	8.0	23.0	32.0	41.0	48.0
Rasch motor function score							
HHA	57.4	14.9	35.2	49.5	57.1	64.6	84.3
IRF	39.9	11.5	12.5	36.2	41.8	46.8	53.0
LTCH	29.3	19.0	2.0	12.0	32.1	43.4	54.7
SNF	41.6	11.8	19.1	38.0	42.9	48.1	56.2
Overall	49.6	17.8	13.3	40.6	49.8	59.8	77.1
Comorbidity index							
HHA	1.7	1.5	0.2	0.5	1.3	2.4	4.6
IRF	2.4	1.8	0.2	1.0	2.0	3.2	6.0
LTCH	4.6	2.9	0.6	2.5	4.3	6.2	9.5
SNF	1.8	1.7	0.2	0.5	1.4	2.5	5.3
Overall	2.2	2.0	0.2	0.6	1.7	3.0	6.2

NOTE: Information in this table comes from the CARE form collected at admission to the PAC setting. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-8
Summary descriptive statistics on per PAC stay/HHA episode total routine resource intensity index by facility type

Setting	Number of stays/ episodes in sample	% stays with positive routine RII	Mean LOS	Mean routine RII	Std. dev.	5th %tile	25th %tile	50th %tile	75th %tile	95th %tile
HHA	4,071	87.40	38.6	5.3	7.3	0.0	1.8	3.9	6.9	14.5
IRF	1,106	100.00	16.9	58.6	42.9	17.0	32.1	49.0	70.1	130.8
LTCH	728	100.00	36.6	161.4	148.3	33.6	71.9	117.1	202.3	426.8
SNF	800	100.00	33.3	50.9	42.9	9.5	20.7	39.4	66.5	131.9

NOTE: RII measured as RN-equivalent hours. Routine RII statistics for HHA include patients with no use (where routine RII = 0). To compare RN hours to therapist hours, multiply these numbers by 1.19 and the therapy numbers by 0.67. This will put the RIIs on the same wage base. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LOS = length of stay; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; RN = registered nurse; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-9
Mean per PAC stay/HHA episode total routine resource intensity index, by age and administrative items and provider type

Administrative/admission item	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
Age 64 years and under	48.7	5.7	72.3	145.6	47.5
Age 65-69 years	49.9	5.2	63.2	174.0	43.7
Age 70-84 years	40.7	6.0	58.2	170.2	52.9
Age 75-79 years	32.3	5.2	56.6	164.7	42.0
Age 80-84 years	34.2	4.8	56.7	188.7	50.3
Age 85 years and above	27.9	5.1	51.6	134.6	56.7
No acute service use in past 2 months	10.8	5.2	60.7	144.9	46.3
Acute service use in past 2 months	43.5	5.3	58.4	161.9	51.0
No prior ICU stay	32.0	5.2	58.5	135.1	51.0
Prior ICU stay of 1 to 14 days	205.7	†	†	207.1	†
Prior ICU stay of more than 14 days	382.7	†	†	382.7	†

† Indicates sample size of less than 11.

NOTE: RII measured as RN-equivalent hours. Routine RII statistics for HHA include patients with no use (where routine RII = 0). To compare RN hours to therapist hours, multiply these numbers by 1.19 and the therapy numbers by 0.67. This will put the RIIs on the same wage base. CRU = cost and resource utilization; HHA = home health agency; ICU = intensive care unit; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; RN = registered nurse; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-10
Mean per PAC stay/HHA episode total routine resource intensity index, by primary diagnosis grouping and provider type

Primary diagnosis	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
Neurologic, stroke	50.0	4.4	70.4	†	66.7
Neurologic, surgical	59.7	5.4	78.5	†	†
Neurologic, medical	20.4	4.7	64.8	†	71.1
Respiratory, ventilator and tracheostomy	209.3	8.9	111.0	245.8	†
Respiratory, surgical	24.2	7.3	†	†	†
Respiratory, medical	36.8	5.8	57.6	117.3	61.9
Respiratory, COPD	24.2	6.9	†	85.2	37.3
Cardiovascular, vascular surgical	40.3	7.7	54.5	129.8	†
Cardiovascular, cardiac surgical	22.9	5.8	49.7	117.2	32.9
Cardiovascular, general	16.8	5.4	49.1	†	69.2
Cardiovascular, vascular medical	13.1	6.1	†	†	†
Cardiovascular, cardiac medical	20.7	6.0	48.8	90.1	49.5
Orthopedic, minor surgical	38.6	4.6	51.2	123.7	65.4
Orthopedic, major surgical	18.9	3.2	43.9	†	32.3
Orthopedic, spinal	33.8	4.1	61.5	†	33.4
Orthopedic, minor medical	14.4	3.8	39.9	†	53.3
Orthopedic, major medical	35.6	4.2	49.8	†	87.2
Integumentary, surgical	83.9	8.7	†	194.7	†
Integumentary, medical	25.6	8.1	†	121.1	49.9
Endocrine, surgical	52.2	†	†	†	†
Endocrine, medical	21.2	6.5	60.4	†	55.5
Kidney and urinary, surgical	33.6	8.1	†	†	†
Kidney and urinary, medical	25.0	5.7	47.0	148.3	45.7
Infections, surgical	96.1	6.9	†	155.8	†
Infections, medical	45.6	6.5	†	†	†
Infections, septicemia	64.9	5.1	71.1	145.8	66.5
Transplant	†	†	†	†	†

(continued)

Table 9-10 (continued)
Mean per PAC stay/HHA episode total routine resource intensity index, by primary diagnosis grouping and provider type

Primary diagnosis	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
GI and hepatobiliary, minor surgical	18.4	5.5	†	†	†
GI and hepatobiliary, major surgical	56.5	7.7	86.2	169.5	42.1
GI and hepatobiliary, minor medical	25.0	4.6	†	114.9	51.8
GI and hepatobiliary, major medical	27.3	4.8	†	90.6	50.5
Hematologic, surgical	32.5	†	†	†	†
Hematologic, medical	17.1	4.5	†	†	†
Other, surgical	46.8	5.5	59.5	125.5	†
Other, medical	16.2	4.3	53.6	†	41.1

† Indicates sample size of less than 11.

NOTE: Primary diagnosis is determined based on the MS-DRG reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the PAC claim was grouped into an MS-DRG. RII measured as RN-equivalent hours. Routine RII statistics for HHA include patients with no use (where routine RII = 0). To compare RN hours to therapist hours, multiply these numbers by 1.19 and the therapy numbers by 0.67. This will put the RIIs on the same wage base. COPD = chronic obstructive pulmonary disease; CRU = cost and resource utilization; GI = gastrointestinal bleeding; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MS-DRG = Medicare Severity-Diagnosis Related Group; PAC = post-acute care; RII = resource intensity index; RN = registered nurse; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-11
Mean per PAC stay/HHA episode total routine resource intensity index, by most common comorbid condition categories and provider type

Comorbid condition category	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
Morbid obesity	98.6	6.8	63.0	187.1	†
Metabolic, diabetes, other endocrine	54.4	5.5	60.9	167.5	54.4
Liver, other GI	60.5	5.4	64.7	184.9	50.8
Orthopedic infection, rheumatism, severe skeletal, musculoskeletal, amputation	37.5	4.7	60.3	155.9	52.1
Psychiatric/depression	68.7	4.9	61.4	169.7	48.7
Head and spine injury	97.8	8.5	99.3	186.7	†
Polyneuropathy, seizure, other neurological	52.2	5.4	56.0	189.7	57.0
Shock, ischemic heart disease, vascular	76.8	6.0	66.3	188.2	56.4
Stroke	65.8	4.7	71.7	189.1	71.7
Pneumonia, pleural effusion, other respiratory	69.4	5.6	62.4	192.5	53.5
Acute and chronic renal	92.1	5.3	70.0	197.6	54.4
Cellulitis	102.6	6.4	60.7	195.3	†
UTI	99.5	5.2	71.0	218.5	57.5

† Indicates sample size of less than 11.

NOTE: RII measured as RN-equivalent hours. Routine RII statistics for HHA include patients with no use (where routine RII = 0). The comorbid conditions are taken from the secondary diagnoses on the prior acute hospital claim and from all diagnoses on the PAC claims. To compare RN hours to therapist hours, multiply these numbers by 1.19 and the therapy numbers by 0.67. This will put the RIIs on the same wage base. CRU = cost and resource utilization; GI = gastrointestinal bleeding; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; RN = registered nurse; SNF = skilled nursing facility; UTI = urinary tract infection.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-12
Mean per PAC stay/HHA episode total routine resource intensity index, by other medical categories and provider type

Medical category	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
Major treatment: total parenteral nutrition	280.5	†	†	307.5	†
Major treatment: central line management	153.9	7.2	82.4	176.6	75.4
Major treatment: hemodialysis	97.9	10.8	57.9	171.9	83.1
Major treatment: ventilator	270.1	†	†	279.4	†
Major treatment: bowel catheter	205.9	†	†	246.9	†
Severe pressure ulcer present	107.3	9.8	74.2	203.5	75.9
No severe pressure ulcer present	32.9	5.1	58.2	151.2	50.0
Major wound present	59.1	8.6	59.6	168.8	64.4
No major wound present	33.8	4.9	58.5	158.9	50.2

† Indicates sample size of less than 11.

NOTE: RII measured as RN-equivalent hours. Routine RII statistics for HHA include patients with no use (where routine RII = 0). Means are reported for cases who received the relevant major treatment in the first two days of their PAC stay. Patient information in this table comes from the CARE form collected at admission to the PAC setting. To compare RN hours to therapist hours, multiply these numbers by 1.19 and the therapy numbers by 0.67. This will put the RIIs on the same wage base. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; RN = registered nurse; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-13
Mean per PAC stay/HHA episode total routine resource intensity index, by cognitive status categories and provider type

Variable name	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
Cognitive status[1]					
Cognitive abilities severely impaired	64.9	5.2	62.9	190.1	57.0
Cognitive abilities moderately impaired	33.2	5.6	56.5	146.2	56.5
Cognitive abilities intact or borderline	27.9	5.2	57.7	130.6	47.8
Missing	121.4	4.0	81.1	264.0	53.7
Depression (feeling sad)[2]					
Depressed (often, always)	35.5	5.9	65.1	121.9	58.2
No interview, comatose, unable to respond, missing	69.6	4.9	56.8	185.8	55.7

[1] Cognitive status was assessed through the Brief Interview for Mental Status (BIMS) and an observation assessment for patients who could not be interviewed.

[2] Patients are asked the question “during the past 2 weeks, how often would you say ‘I feel sad’?”

NOTE: RII measured as RN-equivalent hours. Routine RII statistics for HHA include patients with no use (where routine RII = 0). Information in this table comes from the CARE form collected at admission to the PAC setting. To compare RN hours to therapist hours, multiply these numbers by 1.19 and the therapy numbers by 0.67. This will put the RIIs on the same wage base. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; RN = registered nurse; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-14
Mean per PAC stay/HHA episode total routine resource intensity index, by impairment category and provider type

Variable name	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
Bladder incontinence[1]					
Yes	30.1	5.6	69.3	149.0	61.7
No	38.3	5.1	56.3	163.6	48.5
Bowel incontinence[1]					
Yes	103.2	6.0	79.4	202.8	62.2
No	27.7	5.2	55.7	132.3	49.2
Swallowing symptoms[2]					
Yes	47.9	7.1	76.5	140.5	56.7
No	35.8	5.1	56.6	162.5	50.7
Swallowing: NPO					
Yes	188.7	5.6	108.7	220.9	†
No	28.2	5.2	56.8	126.0	50.5
Expression ideas and wants					
Rarely/never expresses oneself	98.5	9.2	90.3	224.4	69.2
Frequently has difficulty	51.6	4.6	75.7	162.4	63.0
Some difficulty	35.9	5.7	60.7	153.7	59.2
Without difficulty	28.3	5.1	54.5	132.1	48.1
Unknown	185.9	6.1	51.8	232.9	†
Sitting endurance impairment					
No, could not do	117.4	5.6	111.9	187.4	74.4
Yes, can do with support	32.5	5.3	59.3	129.7	60.4
Yes, can do without support	22.7	5.1	52.2	135.4	40.1
Not assessed due to medical restriction	124.0	6.8	57.8	205.8	59.0
Any respiratory impairment[3]					
Yes	36.3	6.2	69.1	122.1	57.2
No	36.5	4.9	56.2	177.6	49.4

† Indicates sample size of less than 11.

1 A patient is considered incontinent if the assessment was marked as "incontinent daily" or "always incontinent."

2 A patient is considered to have symptoms of a possible swallowing disorder if the assessment was marked as "coughing or choking during meals or when swallowing medications," "holding food in mouth/cheeks or residual food in mouth after meals," or "loss of liquids/solids from mouth when eating or drinking."

3 Respiratory impairment is based on the question "does the patient have any impairments with respiratory status?"

NOTE: RII measured as RN-equivalent hours. Routine RII statistics for HHA include patients with no use (where routine RII = 0). Information in this table comes from the CARE form collected at admission to the PAC setting. To compare RN hours to therapist hours, multiply these numbers by 1.19 and the therapy numbers by 0.67. This will put the RIIs on the same wage base. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; RN = registered nurse; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-15
Mean per PAC stay/HHA episode total routine resource intensity index, by functional status and comorbidity index and provider type

Variable name	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
Rasch mobility score					
Lowest quartile	90.7	5.8	75.1	212.9	72.1
Second quartile	36.5	5.5	62.9	200.5	59.7
Third quartile	12.3	5.0	53.4	143.0	38.3
Highest quartile	6.2	4.6	42.9	88.7	33.7
Rasch self-care score					
Lowest quartile	86.7	6.0	75.1	211.7	69.6
Second quartile	35.3	5.4	60.7	204.0	62.5
Third quartile	14.1	4.9	54.4	133.9	40.2
Highest quartile	6.7	4.5	42.2	94.5	29.8
Rasch motor score					
Lowest quartile	91.2	6.1	75.8	214.1	71.8
Second quartile	36.2	5.4	63.8	197.7	61.6
Third quartile	11.9	4.8	53.1	146.3	39.4
Highest quartile	6.2	4.6	41.5	87.0	30.6
Comorbidity index					
Lowest quartile	12.6	4.5	49.0	111.3	35.4
Second quartile	21.4	4.7	56.5	118.6	45.3
Third quartile	32.4	5.5	56.5	197.4	59.9
Highest quartile	79.4	6.2	72.5	218.1	63.5

NOTE: RII measured as RN-equivalent hours. Routine RII statistics for HHA include patients with no use (where routine RII = 0). Information in this table comes from the CARE form collected at admission to the PAC setting. To compare RN hours to therapist hours, multiply these numbers by 1.19 and the therapy numbers by 0.67. This will put the RIIs on the same wage base. CRU = cost and resource utilization; HCC = hierarchical condition category; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; RN = registered nurse; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-16
Summary descriptive statistics on per PAC stay/HHA episode total therapy resource intensity index by facility type

Setting	Number of stays/ episodes in sample	% stays with positive therapy RII	Mean LOS	Mean therapy RII	Std. dev.	5th %tile	25th %tile	50th %tile	75th %tile	95th %tile
HHA	4,071	73.80	38.6	10.1	11.2	0.0	0.0	7.1	16.0	31.8
IRF	1,106	100.00	16.9	47.6	41.8	1.9	19.8	37.4	62.4	126.1
LTCH	728	100.00	36.6	33.1	30.3	1.0	10.3	26.8	46.9	86.5
SNF	800	100.00	33.3	43.9	53.1	0.4	10.3	29.7	60.5	137.5

NOTE: RII measured as licensed therapist-equivalent hours. Therapy RII statistics for HHA include patients with no use (where therapy RII = 0). To compare therapist hours to RN hours, multiply these numbers by 0.67 and the RN numbers by 1.19. This will put the RIIs on the same wage base. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LOS = length of stay; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-17
Mean per PAC stay/HHA episode total therapy resource intensity index, by age and administrative items and provider type

Administrative/admission item	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
Age 64 years and under	21.4	7.9	53.5	26.8	39.8
Age 65-69 years	24.9	9.1	52.6	36.1	31.7
Age 70-84 years	23.0	9.5	48.7	31.8	39.7
Age 75-79 years	21.7	9.8	45.7	41.8	35.9
Age 80-84 years	23.4	10.9	47.7	37.1	43.0
Age 85 years and above	22.7	11.0	41.6	28.4	52.4
No acute service use in past 2 months	13.5	10.6	57.2	20.4	42.2
Acute service use in past 2 months	25.4	9.8	47.0	33.6	44.0
No prior ICU stay	22.6	10.1	47.7	32.9	44.0
Prior ICU stay of 1 to 14 days	25.8	†	†	24.6	†
Prior ICU stay of more than 14 days	39.5	†	†	39.5	†

† Indicates sample size of less than 11.

NOTE: RII measured as licensed therapist-equivalent hours. Therapy RII statistics for HHA include patients with no use (where therapy RII = 0). To compare therapist hours to RN hours, multiply these numbers by 0.67 and the RN numbers by 1.19. This will put the RIIs on the same wage base. CRU = cost and resource utilization; HHA = home health agency; ICU = intensive care unit; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-18
Mean per PAC stay/HHA episode total therapy resource intensity index, by primary diagnosis grouping and provider type

Primary diagnosis	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
Neurologic, stroke	52.3	18.8	67.9	†	73.8
Neurologic, surgical	53.2	17.6	67.9	†	†
Neurologic, medical	21.2	13.3	44.9	†	56.1
Respiratory, ventilator and tracheostomy	43.1	7.5	72.8	43.6	†
Respiratory, surgical	18.3	8.4	†	†	†
Respiratory, medical	19.4	9.4	42.1	28.3	38.4
Respiratory, COPD	12.7	7.0	†	26.9	23.7
Cardiovascular, vascular surgical	22.9	5.5	42.5	31.2	†
Cardiovascular, cardiac surgical	15.1	6.2	40.7	30.4	32.9
Cardiovascular, general	13.5	7.2	38.1	†	54.4
Cardiovascular, vascular medical	12.2	8.1	†	†	†
Cardiovascular, cardiac medical	16.6	7.8	27.8	31.2	46.4
Orthopedic, minor surgical	31.4	13.1	38.0	35.8	56.1
Orthopedic, major surgical	20.3	13.3	35.0	†	24.2
Orthopedic, spinal	28.4	10.3	50.1	†	25.9
Orthopedic, minor medical	21.1	12.9	30.8	†	61.4
Orthopedic, major medical	35.0	12.4	43.4	†	80.1
Integumentary, surgical	15.9	2.6	†	21.6	†
Integumentary, medical	12.7	5.1	†	20.7	50.5
Endocrine, surgical	29.4	†	†	†	†
Endocrine, medical	20.6	9.2	42.3	†	60.3
Kidney and urinary, surgical	16.5	7.0	†	†	†
Kidney and urinary, medical	16.6	8.8	42.3	22.3	36.6
Infections, surgical	24.2	6.5	†	25.8	†
Infections, medical	19.3	6.5	†	†	†
Infections, septicemia	25.0	11.7	51.9	33.0	26.0
Transplant	†	†	†	†	†

(continued)

Table 9-18 (continued)
Mean per PAC stay/HHA episode total therapy resource intensity index, by primary diagnosis grouping and provider type

Primary diagnosis	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
GI and hepatobiliary, minor surgical	14.7	5.5	†	†	†
GI and hepatobiliary, major surgical	20.0	5.2	62.0	30.1	35.5
GI and hepatobiliary, minor medical	14.7	8.4	†	18.1	40.5
GI and hepatobiliary, major medical	18.5	9.2	†	20.9	40.4
Hematologic, surgical	17.5	†	†	†	†
Hematologic, medical	11.9	5.1	†	†	†
Other, surgical	23.9	7.8	48.2	31.9	†
Other, medical	19.5	11.7	51.8	†	48.7

† Indicates sample size of less than 11.

NOTE: Primary diagnosis is determined based on the MS-DRG reported on the claim for the previous acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the PAC claim was grouped into an MS-DRG. RII measured as licensed therapist-equivalent hours. Therapy RII statistics for HHA include patients with no use (where therapy RII = 0). To compare therapist hours to RN hours, multiply these numbers by 0.67 and the RN numbers by 1.19. This will put the RIIs on the same wage base. COPD = chronic obstructive pulmonary disease; CRU = cost and resource utilization; GI = gastrointestinal bleeding HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MS-DRG = Medicare Severity-Diagnosis Related Group: PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-19
Mean per PAC stay/HHA episode total therapy resource intensity index, by most common comorbid condition categories and provider type

Comorbid condition category	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
Morbid obesity	28.0	8.6	47.0	31.8	†
Metabolic, diabetes, other endocrine	26.7	10.1	49.5	33.9	42.7
Liver, other GI	29.7	10.1	52.5	35.7	36.5
Orthopedic infection, rheumatism, severe skeletal, musculoskeletal, amputation	26.4	11.5	48.7	32.0	44.9
Psychiatric/depression	30.9	9.2	46.8	33.5	45.2
Head and spine injury	42.1	9.7	73.0	29.3	†
Polyneuropathy, seizure, other neurological	26.4	12.1	43.9	31.7	43.7
Shock, ischemic heart disease, vascular	30.7	9.7	53.5	37.5	36.4
Stroke	48.3	16.2	65.7	34.3	74.7
Pneumonia, pleural effusion, other respiratory	26.8	9.1	49.6	36.9	41.3
Acute and chronic renal	31.5	7.9	56.0	33.7	47.0
Cellulitis	30.3	8.0	41.1	35.2	†
UTI	42.0	9.8	59.8	36.6	42.9

† Indicates sample size of less than 11.

NOTE: RII measured licensed therapist-equivalent hours. Therapy RII statistics for HHA include patients with no use (where therapy RII = 0). The comorbid conditions are taken from the secondary diagnoses on the prior acute hospital claim and from all diagnoses on the PAC claims. To compare therapist hours to RN hours, multiply these numbers by 0.67 and the RN numbers by 1.19. This will put the RIIs on the same wage base. CRU = cost and resource utilization; GI = gastrointestinal bleeding; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility; UTI = urinary tract infection.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-20
Mean per PAC stay/HHA episode total therapy resource intensity index, by other medical categories and provider type

Medical category	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
Major treatment: total parenteral nutrition	37.5	†	†	38.6	†
Major treatment: central line management	35.4	3.7	52.9	34.4	33.5
Major treatment: hemodialysis	24.9	6.9	41.6	26.4	52.1
Major treatment: ventilator	43.2	†	†	43.1	†
Major treatment: bowel catheter	36.9	†	†	37.8	†
Severe pressure ulcer present	27.5	8.1	57.5	32.7	51.7
No severe pressure ulcer present	22.6	10.1	47.4	33.2	43.7
Major wound present	21.1	7.6	47.9	34.4	50.3
No major wound present	23.0	10.3	47.7	32.7	43.6

† Indicates sample size of less than 11.

NOTE: RII measured as licensed therapist-equivalent hours. Therapy RII statistics for HHA include patients with no use (where therapy RII = 0). Means are reported for cases who received the relevant major treatment in the first two days of their PAC stay. Patient information in this table comes from the CARE form collected at admission to the PAC setting. To compare therapist hours to RN hours, multiply these numbers by 0.67 and the RN numbers by 1.19. This will put the RIIs on the same wage base. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-21
Mean per PAC stay/HHA episode total therapy resource intensity index, by cognitive status categories and provider type

Variable name	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
Cognitive status[1]					
Cognitive abilities intact or borderline	29.6	10.8	51.8	36.1	56.4
Cognitive abilities moderately impaired	25.0	11.1	48.0	35.8	56.2
Cognitive abilities severely impaired	20.2	9.6	46.1	29.8	37.4
Missing	25.1	10.2	56.2	30.9	36.3
Depression (feeling sad)[2]					
Depressed (often, always)	26.2	11.4	51.4	34.1	54.6
No interview, comatose, unable to respond, missing	27.1	10.7	43.6	33.6	56.9

[1] Cognitive status was assessed through the Brief Interview for Mental Status (BIMS) and an observation assessment for patients who could not be interviewed.

[2] Patients are asked the question "during the past 2 weeks, how often would you say 'I feel sad'?"

NOTE: RII measured as licensed therapist-equivalent hours. Therapy RII statistics for HHA include patients with no use (where therapy RII = 0). Information in this table comes from the CARE form collected at admission to the PAC setting. To compare therapist hours to RN hours, multiply these numbers by 0.67 and the RN numbers by 1.19. This will put the RIIs on the same wage base. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-22
Mean per PAC stay/HHA episode total therapy resource intensity index, by impairment category and provider type

Variable name	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
Bladder incontinence[1]					
Yes	23.2	11.2	58.4	29.6	56.9
No	22.7	9.7	45.3	33.8	41.0
Bowel incontinence[1]					
Yes	36.2	11.1	61.2	37.4	54.3
No	21.1	10.0	45.8	30.1	42.3
Swallowing symptoms[2]					
Yes	37.2	14.4	63.8	35.0	65.6
No	22.0	9.9	45.9	33.0	42.9
Swallowing: NPO					
Yes	43.5	12.4	82.3	40.0	†
No	21.7	10.0	46.4	29.0	43.6
Expression ideas and wants					
Rarely/never expresses oneself	39.8	9.6	63.2	41.7	95.1
Frequently has difficulty	33.2	12.7	64.7	38.0	59.2
Some difficulty	24.7	11.2	53.5	33.1	56.2
Without difficulty	20.6	9.6	43.3	30.6	39.8
Unknown	32.3	4.7	37.2	34.8	†
Sitting endurance impairment					
No, could not do	37.7	10.8	85.8	37.5	52.3
Yes, can do with support	25.7	11.0	51.0	33.9	54.4
Yes, can do without support	18.0	9.4	39.8	28.3	35.9
Not assessed due to medical restriction	27.0	8.3	50.2	30.2	31.4
Any respiratory impairment[3]					
Yes	21.7	8.7	52.2	30.6	47.1
No	23.1	10.5	46.6	34.1	43.2

† Indicates sample size of less than 11.

[1] A patient is considered incontinent if the assessment was marked as “incontinent daily” or “always incontinent.”

[2] A patient is considered to have symptoms of a possible swallowing disorder if the assessment was marked as “coughing or choking during meals or when swallowing medications,” “holding food in mouth/cheeks or residual food in mouth after meals,” or “loss of liquids/solids from mouth when eating or drinking.”

[3] Respiratory impairment is based on the question “does the patient have any impairments with respiratory status?”

NOTE: RII measured as licensed therapist-equivalent hours. Therapy RII statistics for HHA include patients with no use (where therapy RII = 0). Information in this table comes from the CARE form collected at admission to the PAC setting. To compare therapist hours to RN hours, multiply these numbers by 0.67 and the RN numbers by 1.19. This will put the RIIs on the same wage base. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-23
Mean per PAC stay/HHA episode total therapy resource intensity index, by functional status and comorbidity index and provider type

Variable name	Overall mean	HHA mean	IRF mean	LTCH mean	SNF mean
Rasch mobility score					
Lowest quartile	41.3	13.6	60.5	35.7	60.9
Second quartile	27.9	11.0	53.3	35.1	52.6
Third quartile	14.4	9.2	40.3	35.5	32.2
Highest quartile	7.7	6.5	36.5	26.2	30.2
Rasch self-care score					
Lowest quartile	39.5	13.5	60.7	37.3	58.5
Second quartile	27.9	10.3	50.1	35.8	55.2
Third quartile	14.7	9.5	44.3	33.2	33.9
Highest quartile	8.1	6.7	34.1	26.0	26.9
Rasch motor score					
Lowest quartile	41.2	13.7	61.3	34.8	58.9
Second quartile	28.4	10.9	52.7	37.1	55.4
Third quartile	13.8	9.2	42.2	34.7	33.3
Highest quartile	7.7	6.4	34.3	25.8	27.9
Comorbidity index					
Lowest quartile	14.9	10.0	42.5	27.5	32.9
Second quartile	18.9	9.5	45.0	32.0	37.4
Third quartile	26.7	10.2	47.9	35.9	58.0
Highest quartile	30.7	10.5	55.3	37.1	47.9

NOTE: RII measured as licensed therapist-equivalent hours. Therapy RII statistics for HHA include patients with no use (where therapy RII = 0). Information in this table comes from the CARE form collected at admission to the PAC setting. To compare therapist hours to RN hours, multiply these numbers by 0.67 and the RN numbers by 1.19. This will put the RIIs on the same wage base. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-24
MSE-based R-squareds for stay/episode-level routine resource intensity index models from the May 2011 Report to Congress Supplement Report

Model	Setting indicators only	Patient acuity covariates only	Setting & patient acuity measures
All-PAC Settings[1]	0.448	0.636	0.708
HHA–Inpatient PAC Settings[2]	0.448	0.704	0.710
Setting Specific[3]	NA	NA	0.735

[1] The All-PAC Settings models are composed of two components: (1) a component predicting whether routine services are used and (2) a component predicting the amount of services used if positive.

[2] The HHA–Inpatient PAC Settings models are composed of three components: (1) an HHA-only component predicting whether routine services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) an inpatient-only component predicting the amount of services used.

[3] The Setting-Specific models are composed of five components: (1) an HHA-only component predicting whether routine services are used; (2) an HHA-only component predicting the amount of services used if positive; and (3) separate IRF-, LTCH-, and SNF-specific components predicting the amount of services used.

NOTE: All models include 6,705 patients in the CRU sample, and total sample predicted average routine RII is set equal to the total sample actual average routine RII within each group of settings for which separate case-mix weights are estimated. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MSE = mean-squared error; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-25
Ratio of predicted to actual routine resource intensity index for stay/episode-level routine resource intensity index models, by setting from the May 2011 Report to Congress Supplement Report

Model	HHA ratio	IRF ratio	LTCH ratio	SNF ratio
All-PAC Settings[1]	3.52	0.77	0.81	0.59
All-PAC plus Setting Indicators[1]	1.00	1.00	1.00	1.00
HHA–Inpatient PAC Settings[2]	1.00	1.10	0.94	1.01
HHA–Inpatient plus Setting Indicators[2]	1.00	1.00	1.00	1.00
Setting Specific[3]	1.00	1.00	1.00	1.00

[1] The All-PAC Settings models are composed of two components: (1) a component predicting whether routine services are used and (2) a component predicting the amount of services used if positive.

[2] The HHA–Inpatient PAC Settings models are composed of three components: (1) an HHA-only component predicting whether routine services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) an inpatient-only component predicting the amount of services used.

[3] The Setting-Specific models are composed of five components: (1) an HHA-only component predicting whether routine services are used; (2) an HHA-only component predicting the amount of services used if positive; and (3) separate IRF-, LTCH-, and SNF-specific components predicting the amount of services used.

NOTE: All models include 6,705 patients in the CRU sample, and total sample predicted average routine RII is set equal to the total sample actual average routine RII within each group of settings for which separate case-mix weights are estimated. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-26
Ratio of predicted to actual therapy resource intensity index for stay/episode-level therapy resource intensity index models, by setting from the May 2011 Report to Congress Supplement Report

Model	HHA ratio	IRF ratio	LTCH ratio	SNF ratio
All-PAC Settings[1]	1.54	0.82	1.01	0.62
All-PAC plus Setting Indicators[1]	1.00	1.00	1.00	1.00
HHA–Inpatient PAC Settings[2]	1.00	1.01	1.15	0.89
HHA–Inpatient plus Setting Indicators[2]	1.00	1.00	1.00	1.00
Setting Specific[3]	1.00	1.00	1.00	1.00

[1] The All-PAC Settings models are composed of two components: (1) a component predicting whether therapy services are used and (2) a component predicting the amount of services used if positive.

[2] The HHA–Inpatient PAC Settings models are composed of three components: (1) an HHA-only component predicting whether therapy services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) an inpatient-only component predicting the amount of services used.

[3] The Setting-Specific models are composed of five components: (1) an HHA-only component predicting whether therapy services are used; (2) an HHA-only component predicting the amount of services used if positive; and (3) separate IRF-, LTCH-, and SNF-specific components predicting the amount of services used.

NOTE: All models include 6,705 patients in the CRU sample, and total sample predicted average therapy RII is set equal to the total sample actual average therapy RII within each group of settings for which separate case-mix weights are estimated. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 9-27
MSE-based R-squareds for stay/episode-level therapy resource intensity index models from the May 2011 Report to Congress Supplement Report

Model	Setting indicators only	Patient acuity covariates only	Setting & patient acuity measures
All-PAC Settings[1]	0.249	0.255	0.350
HHA-versus-Inpatient PAC settings[2]	0.249	0.343	0.360
Setting Specific[3]	NA	NA	0.445

[1] The All-PAC Settings models are composed of two components: (1) a component predicting whether therapy services are used and (2) a component predicting the amount of services used if positive.

[2] The HHA–Inpatient PAC Settings models are composed of three components: (1) an HHA-only component predicting whether therapy services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) an inpatient-only component predicting the amount of services used.

[3] The Setting-Specific models are composed of five components: (1) an HHA-only component predicting whether therapy services are used; (2) an HHA-only component predicting the amount of services used if positive; and (3) separate IRF-, LTCH-, and SNF-specific components predicting the amount of services used.

NOTE: All models include 6,705 patients in the CRU sample, and total sample predicted average therapy RII is set equal to the total sample actual average therapy RII within each group of settings for which separate case-mix weights are estimated. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MSE = mean-squared error; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

SECTION 10
DETERMINANTS OF RESOURCE INTENSITY: LESSONS LEARNED FROM THE CART ANALYSES

10.1 Introduction

Section 9 describes the data used in the modeling of the routine and therapy resource intensity indexes and presents an overview of the results that were presented in the Interim Report for this project. Section 10 describes the results of subsequent exploratory modeling efforts and refinements. The primary approach described in this section is classification and regression tree (CART) analysis. In this technique, described more completely below, CART is used to split the sample of interest into two subsamples based on values of the explanatory variable that best creates subsamples that are similar in resource intensity within each subsample and different between subsamples. Each of these subsamples is split again, usually on the basis of a different explanatory variable. Each split is conditional on the splits made previously. The average value of the resource intensity for each group is the prediction of the resource intensity index for the members of that group. The variables that have the most power in creating splits are of most interest.

We report on the results of a series of regression tree analyses meant to predict the level of the resource intensity index (RII) of care across the four different post-acute care (PAC) settings: home health agencies (HHAs), inpatient rehabilitation facilities (IRFs), long-term care hospitals (LTCHs), and skilled nursing facilities (SNFs). The analyses examine routine nursing care and therapy services separately. The section begins with a description of regression tree analysis and then describes principal findings with regard to the following issues, similar to those described in Section 9:

- What are the most important factors in predicting the routine and therapy RII?
- How feasible is it to create a model that spans PAC settings?
- What type of substitutability exists among the possible explanatory variables?

The results of the exploratory work presented in this chapter are then applied to the analyses presented in Section 11 of this report.

10.2 Brief Description of Regression Tree Analysis

Regression tree analysis is a nonparametric statistical technique that is used to identify important patterns among a set of candidate explanatory variables that help to predict the value of a given dependent or target variable (such as the amount of nursing care a patient receives during a PAC stay). Starting with the entire sample (or parent node), the model compares all explanatory variables at all possible threshold levels and chooses that variable (and threshold level) that best splits the sample into more homogeneous subsamples (or child nodes). Analogous to linear regression, the optimal split is determined as the split that provides the greatest decrease to the sum of squared errors or the greatest increase in the fit of the model. The process repeats itself at each subsample or child node until further splitting is stopped or impossible. If a node cannot be split, it is labeled as a terminal node. To avoid the issue of having terminal nodes representing very small numbers of patients, we applied the following constraint. No terminal node could have fewer than 10 observations, which implies that any node with fewer than 20 observations could not be split. Terminal nodes with fewer than 10 patients would be unlikely to be relevant statistically.

Despite this constraint, the process can result in very large trees with well over 100 terminal nodes. This raises the possibility of overfitting the data, which is a case where the model is modeling the random component of the variation in the target variable. Such a model would be unlikely to make good predictions if it were applied to new data. Typically, the sample is subdivided for the purposes of cross validation as a means of pruning the tree until it comes to the optimal tree, where cross-validated relative error is minimized. More heuristically, the optimal tree is the one that would perform best at predicting the value of the dependent variable if the tree were applied to a new sample. In tenfold cross validation, for example, the sample is divided into 10 subsamples of roughly equal size, each having a similar distribution of the dependent variable. Next, a tree is grown using the data from nine of these subsamples and then applied to the remaining subsample as the test sample for determining the out-of-sample performance of the tree. This process is repeated until each of the 10 subsamples has been used as a test sample. The out-of-sample results for the 10 test samples are then combined to determine the optimal number of terminal nodes for the full sample. This is done for all of the tree sizes modeled.

While a regression tree diagram shows the splitters and the relationships among them that help predict the RII, another important piece of information provided is the ranking of explanatory variables by a “variable importance” score. It is possible for a variable to be slightly outperformed by another as a splitter and thus never appear in the tree, even though it has more information to predict the RII than other splitters that do appear in subsequent nodes. This is called the “masking” problem, which is similar to the case of one of two strongly collinear variables dropping out in a standard regression analysis. The variable importance score ranks the explanatory variables by considering the potential effect of each variable in predicting the value of the dependent variable, even when the variable may never appear in the tree. The index score is equal to 100 for the most important explanatory variable. The score for each of the other variables indicates how important it is relative to the most important variable. It is useful to assess the importance of an explanatory variable based on its overall ranking among all available explanatory variables. Comparing variable importance scores across specifications is not advised, because of the fact that the score for any individual variable is based on its relative importance in relation to the most important variable considered in that specification.

10.3 Specifications Considered

The regression tree analyses were conducted to improve our understanding of how various factors drive both the routine/nursing and therapy RIIs across settings. Another important question that needed to be answered was whether the key findings in the Interim Report regarding the creation of successful models that span settings were robust to a change in modeling approach. To address these issues, we considered the following specifications:

10.3.1 All-PAC Settings Models

Specification 1. In this specification, observations from all settings were pooled, and settings indicators were included as candidate explanatory variables. The other candidate explanatory variables are those described in Section 9.3.1 of this report.

Specification 2. In this specification, observations from all settings were pooled, and settings indicators were *not* included as candidate explanatory variables. The other candidate explanatory variables are those described in Section 9.3.1 of this report.

10.3.2 Inpatient PAC Settings Models

Specification 3. In this specification, observations from the three inpatient settings were pooled, and settings indicators were included as candidate explanatory variables. The other candidate explanatory variables are those described in Section 9.3.1 of this report.

Specification 4. In this specification, observations from the three inpatient settings were pooled, and settings indicators were *not* included as candidate explanatory variables. The other candidate explanatory variables are those described in Section 9.3.1 of this report.

Note that specifications 3 and 4 differ from the HHA-Inpatient PAC Settings model presented in Section 9 in that the HHA portion is not included here.

10.3.3 Setting-Specific Models

Specification 5. In this specification, only observations for HHA episodes were included. The candidate explanatory variables included are those described in Section 9.3.1 of this report.

Specification 6. In this specification, only observations for LTCH episodes were included. The candidate explanatory variables included are those described in Section 9.3.1 of this report.

Specification 7. In this specification, only observations for SNF episodes were included. The candidate explanatory variables included are those described in Section 9.3.1 of this report.

Specification 8. In this specification, only observations for IRF episodes were included. The candidate explanatory variables included are those described in Section 9.3.1 of this report.

Specifications 1 through 4 are most useful when considering the ability to create a successful single model that can explain variation of each RII within multiple settings. Specifications 5 through 8 are useful in considering the question of whether the same factors are important predictors of the RIIs across settings.

10.3.4 Diagnosis Group-Specific Inpatient PAC Setting Models

Four additional specifications were also considered. In these specifications, the inpatient PAC observations were stratified into four broad groups based on primary diagnosis. HHA cases were not modeled under these specifications. The objective was to create broad primary diagnostic groups based on the primary medical, surgical, or injury-related diagnoses for which patients were originally hospitalized. The grouping strategy for these diagnoses was to combine conditions expected to cause similar disabling impairments. Consequently, each group has diagnoses that affect the function or structure of similar organs, thus having similar effects on how they regulate the ways and manners in which people can perform self-care, on mobility, and on cognitive activities. The four broad diagnostic groups were the following:

Specification 9: Inpatient PAC Neurologic Conditions. This group includes patients with one of the three neurological primary diagnoses described in table 5-1 of this report: stroke, along with medical and surgical neurologic diagnoses. These diagnoses represent 27 percent of the IRF sample, 9 percent of the SNF sample, and 4 percent of the LTCH sample.

Specification 10: Inpatient PAC Orthopedic Conditions. This group includes patients with a primary diagnosis in one of the five orthopedic categories: minor and major orthopedic surgery, minor and major orthopedic medical diagnoses, and conditions related to the spinal column. These diagnoses represent 35 percent of the IRF sample, 42 percent of the SNF sample, and 6 percent of the LTCH sample.

Specification 11: Inpatient PAC Respiratory Conditions. This group includes patients with primary diagnosis in one of the four respiratory categories: ventilator/tracheostomy, chronic obstructive pulmonary disease (COPD), respiratory surgeries, and other medical diagnoses related to the respiratory system. These diagnoses represent 7 percent of the IRF sample, 11 percent of the SNF sample, and 43 percent of the LTCH sample.

Specification 12: Inpatient PAC Other Medical/Surgical Conditions. This group includes patients with a primary diagnosis that does not belong to any of the other three categories. This category represents 32 percent of the IRF sample, 39 percent of the SNF sample, and 47 percent of the LTCH sample.

Clearly, PAC trajectories, patient need, and the types of PAC care required and prognosis (expected outcomes) will differ for patients with neurological diagnoses compared with orthopedic, general medical/surgical, or respiratory-related primary diagnoses during acute care. Moreover, stratification based on these global categories will capture or approximate some setting differences based on patient rather than process-related factors. For example, patients with health issues related to recently disabling neurologic diagnoses will tend to have focal impairments in strength, balance, sensation, or movement disorders.

10.4 Drivers of Resource Intensity across Settings and Diagnostic Groups

In this section, the most important drivers of the RIIs are examined. The section is divided into two subsections, one on the routine RII and one on the therapy RII.

For the analyses reported on in the remainder of Section 10, the sample has been limited to those HHA episodes and inpatient PAC stays where the patient entered the PAC setting after having been discharged from an acute inpatient stay within the past 100 days. This limitation decreased the overall sample size from 6,705 to 5,887 stays/episodes. The number of HHA episodes in the sample fell by 19 percent, from 4,071 to 3,312. The total number of inpatient PAC stays fell by 2.25 percent, from 2,634 to 2,575. The majority of the lost inpatient PAC stays were IRF stays, where the sample size fell from 1,106 to 1,066. The sample sizes for the LTCHs and SNFs fell by 11 and 8 stays, respectively. This change allowed us to have a consistent source of patient information for the modeling.

10.4.1 Results for the Routine RII

The relative importance of the specific patient acuity measures in each of the four Setting-Specific models (specifications 5-8) of the routine RII was examined to compare the importance of the specific measures across settings. **Table 10-1** presents the most important factors in explaining variation in routine RI within each of the four PAC settings. The most striking result is that the top three most important predictors of routine RII for LTCH stays have no relevance in the other settings. Length of ICU stay is by far the most important factor in explaining variation in the routine RII in the LTCHs, followed by ventilator treatment (29.1) and the primary diagnosis of ventilator/tracheostomy. Given that there are so few patients in the HHA, SNF, and IRF samples with an ICU stay, this variable was not found to be an important splitter in the CART analyses for these settings.

The Rasch mobility and self-care scores and the comorbidity index are among the variables that are important predictors of routine RII across all settings. These three variables are the three most important variables in the SNF model and the second, third, and fourth most important variables in the IRF (where the relative importance scores range from 92.1 to 67.9) and HHA models. The relative importance of these three variables in the HHA model is much lower, ranging from 11.1 to 6.6. The Rasch scores and comorbidity index are less important in the LTCH model. They do play a role, although the role is relatively small when compared with length of ICU stay and ventilator use (relative importance scores between 17.3 and 12.0).

Other variables that rank as being important in both the IRF and SNF settings include sitting endurance and expressive impairment. Age and bowel incontinence seem to be relatively more important in the IRFs than in the SNFs, and age plays a role across all four settings.

The relative importance of the specific patient acuity measures in predicting routine RII for inpatient PAC stays within each of the four diagnostic groups was also examined (specifications 9-12). **Table 10-2** presents the results of these analyses, For these analyses the HHA episodes have been excluded. For the neurologic and orthopedic patients, the Rasch scores and comorbidity index play the three biggest roles in driving the routine RII. The self-care score is most important for patients with the neurological conditions where one would expect upper and lower extremity involvement. In contrast, for orthopedic patients, in whom lower extremity impairment tends to be predominant—due to large numbers of people with joint replacement and hip fracture—the mobility score (relative importance equal to 85.1) is slightly more important than the self-care score (relative importance of 81.6). All three variables also help explain variation in the routine RII for the other diagnosis groups, showing up as the second through fourth most important factors in the other medical/surgical group and in the fifth, sixth, and eighth positions for the respiratory group.

Length of ICU stay is by far the most important factor in explaining the routine RII for the other medical/surgical and respiratory patients. The second most important factor in explaining variation in the routine RII for other medical/surgical patients is the comorbidity index, which has a relative importance of only 33.6. The second most important factor for respiratory patients is no intake by mouth (NPO), which has a relative importance of 58.8. Length of ICU stay is relevant in the orthopedic model (with a relative importance of 21.2), although it is not among the most important predictors of the routine RII for these patients.

Sitting endurance has relatively high importance in the neurologic model and plays a role in the medical/surgical and orthopedic models, although not as large a role. Bowel incontinence plays a role in each of the models, although never a very large role. Age also plays a role across all patient types, with the greatest relative importance being for the neurologic patients. Bladder incontinence also plays a role in explaining variation in the routine RII for neurologic and orthopedic patients.

The pattern of patient acuity factors that are most important for respiratory patients is different from the ones found in the other diagnostic groups. After ICU days, the presence of a tracheostomy and use of a ventilator are important factors in the respiratory model, but they are not relevant for the other types of patients. NPO status was also an important factor for the respiratory patients but only of marginal relative importance for medical/surgical patients (relative importance equal to 8.7).

10.4.2 Results for the Therapy RII

Next, the relative importance of the various patient acuity factors in the prediction of the therapy RII was examined. **Table 10-3** presents the most important factors in explaining variation in the therapy RII separately within each of the four PAC settings (specifications 5-8). The Rasch self-care and mobility scores are generally very important drivers of therapy RII. For example, in HHAs the self-care score is the most important factor in predicting the therapy RII and the mobility score is the second most important factor, with a relative score of 90 percent. The next most important driver of therapy RI in HHAs is a stroke diagnosis with a much lower relative score of 32 percent. The two Rasch scores are also the two most important factors among SNF patients and rank first and third among the important drivers of the therapy RII in IRFs. Finally, the two Rasch scores rank third and fourth in variable importance for the LTCH model and both have high relative importance. The self-care score has a relative importance of 94 percent, and the mobility score has a relative importance of 73 percent.

The comorbidity index is also an important factor in explaining variation in the therapy RII across all settings. Its relative importance is highest in the IRFs (98.2 percent), but it is also high in the SNFs (58 percent) and the LTCHs (48 percent). The index is also important in the HHA model, although its relative importance in this model is lower (13 percent). Age is another factor that is an important driver of the therapy RII across settings. It is the most important factor for LTCH patients and among the top 5 factors for SNF and HHA patients, where the relative importance is 50.3 and 13.6 percent, respectively. Its relative importance as a driver of the therapy RII in IRFs is also fairly high (56.3 percent).

Some factors are important drivers of therapy RII in some settings but not in others. For example, a history of stroke (either as a primary diagnosis or a comorbidity) is important in explaining the therapy RII for HHA and IRF patients but not important for LTCH and SNF patients. The presence of expressive impairments is important in explaining the therapy RII for

SNF and IRF patients but does not qualify as an important variable for LTCH and HHA patients using this approach. Ventilator use and the number of ICU days are important drivers of the therapy RII in the LTCHs but not in the other settings. This may be related to the number of patients with those characteristics. Sitting endurance is important in explaining therapy RI for LTCH and IRF patients but not important for SNF and HHA patients.

Table 10-4 presents the most important factors in explaining variation in the therapy RII for inpatient PAC stays within each of the four diagnostic groups (specifications 9-12). The same four factors—the Rasch mobility and self-care scores, the comorbidity index, and age—are the four most important factors in predicting the therapy RII regardless of which diagnostic group a patient is in.

Other factors are important across multiple diagnostic groups. For example, the stroke comorbidity is important in explaining the therapy RII among respiratory, orthopedic, and neurologic patients, although the relative importance varies from 35 percent for respiratory patients to 18.7 percent for orthopedic patients . Sitting endurance is important among orthopedic, neurologic, and medical/surgical patients, and cognitive status is important for all patients. Again, the relative importance varies across the diagnostic groups. Bowel incontinence is important for medical/surgical and orthopedic patients, and bladder incontinence is important for neurologic and respiratory patients. Impairments related to expressive function are important for orthopedic and respiratory patients.

While ventilator use and the number of ICU days are very important factors in predicting the routine RII for respiratory patients, neither is very important in predicting the therapy RII for this population. Likewise, the number of ICU days does not appear to be an important driver of the therapy RII for medical/surgical patients. This contrasts with the variable's role in predicting the routine RII for these patients, where it played the most important role.

10.5 Creating a Model That Spans Settings

In the Interim Report: Supplemental Results to the RTC, the regression results suggested the possible future development of a common payment system for the three inpatient PAC settings. The same issue was considered when doing the CART analyses. Two sets of CART models were run.

The main question was whether CART, when the setting indicators were excluded, could generate models that perform as well as models where setting indicators were included to explain variation in resource intensity. Exploratory model performance was measured primarily in terms of within-sample fit using the R-squared statistic.

One issue with the use of CART is that several different models or trees are generated in each case. For instance, in the analysis of specification 1 for the routine RII, CART generated a sequence of increasingly larger trees, each with additional splits added to the prior tree in the sequence. When the setting indicators were included, there were 320 increasingly larger trees, and when the setting indicators were excluded, there were 339 trees. This raises the question, "If one is comparing the performance of the models with and without setting indicators, which particular models (or trees) should one compare?" Because the R-squared (used to measure in-sample performance) increases monotonically with the number of splits (or terminal nodes), the in-sample fit of entire tree sequences was compared. This allowed for an evaluation of whether consistent patterns emerged regardless of model size.

10.5.1 Results for Routine/Nursing Models

Figure 10-1 compares the fit for the routine RII models where observations were pooled across all settings (specifications 1 and 2). The results are consistent with the results from the RTC, in that they suggest that a common payment system across all four settings, including both the inpatient PAC settings and HHA, would not be advisable. Both the R-squared and predictive ratios are improved when the HHA is isolated from the inpatient PAC settings. The predictive ratio for HHAs in specification 2 is 2.4.[17] The R-squared is substantially better for the models where setting indicators are available for use as explanatory variables. For instance, at 20 terminal nodes, the model that includes setting has an R-squared equal to 0.723, and the model that excludes setting has an R-squared equal to 0.624. This 10 percentage point difference persists as larger models are considered.

The results from the regression analyses in the RTC indicated that the HHA episodes should be considered separately from the inpatient PAC stays. This is supported by the results illustrated in the regression tree in **Figure 10-2**. The CART results go further than this, suggesting that LTCHs may need to be modeled separately as well. The initial split generated by this method is on whether the patient was in an LTCH; then the next split for non-LTCH patients is on the HHA indicator variable. The next split for LTCH patients is on whether the patient had a very long (longer than 9 weeks) ICU stay. This is a small group. After three splits, the model has created four separate categories of patients: HHA patients, SNF/IRF patients, LTCH patients with very long ICU stays, and other LTCH patients. An interesting result is that the IRF and SNF patients are not split unless a very large model with more than 50 terminal nodes is chosen. The split only occurs for a relatively small group of patients. This result has led to the inclusion of a new model in the multivariate regression section where the routine RIIs for HHA and LTCH patients are modeled separately, and the routine RIIs for SNF/IRF patients are modeled jointly (see Section 11).

The analyses described thus far confirm the result from the RTC that a model that spans all settings, including HHAs, is not advisable. To determine whether one can create a model that spans the inpatient PAC settings, specifications 3 and 4 are considered. The results shown in **Figure 10-3** indicate that including the setting indicators does not significantly improve the R-squared. This is despite the fact that the LTCH variable is still very important in specification 3 (see **Figure 10-4**). In this case, other variables or combinations of variables, such as ICU days, were found that could substitute for LTCH in the model (see **Figure 10-5**). The clinical information alone could predict 65 to 70 percent of variation in routine RI, while adding the setting indicators improved the fit of the model by roughly 1 percentage point. This result is supportive of the result in the RTC that it may be possible to create a model that spans the inpatient PAC settings.

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[17] The predictive ratio is defined in Section 9.2.3.4. It compares the model's average predicted RII to the average of the actual RII. If the ratio is greater than 1, then the model overpredicts the RII. If the ratio is less than 1, then the model underpredicts the RII.

10.5.2 Results for the Therapy Models

One important result is that the therapy models generally do not do as well as the routine care models with regard to fit. This again is consistent with the regression results from the RTC.

Figure 10-6 compares the within-sample performance of the all-settings models for therapy resource intensity (specifications 1, with setting indicators, and 2, without setting indicators). The results mirror those presented in **Figure 10-1.** The inclusion of the setting variables greatly increases the model's R-squared statistic. The difference in the R-squareds is generally 10 percentage points for any trees with at least 10 terminal nodes. Both the R-squared and predictive ratios are improved when the HHA is isolated from the inpatient PAC settings. The predictive ratio for HHAs in specification 2 is 1.4. Again, it appears that a model spanning all four settings is not recommended.

This result is not surprising if the regression tree for specification 1 is considered (see **Figure 10-7**). The initial split is on HHA. For the non-HHA patients with Rasch self-care scores less than 29 (roughly 70 percent of all such patients), the model splits on whether the patient was in an LTCH. Again, the SNF/IRF patients are not split based on setting.

Figure 10-8 compares the within-sample performance of the PAC inpatient settings models (specifications 3 and 4) of the therapy RII. Here the inclusion of the setting variables improves the R-squared, but less markedly so. The improvement in the R-squared is roughly 2 to 3 percentage points. This improvement in the R-squared is likely because LTCH is an important splitter in specification 3 (see **Figure 10-9**). Again, the LTCH indicator is the primary splitter for all patients with Rasch self-care scores of less than 29. The SNF and IRF patients are not split based on setting. This indicates that modeling LTCH patients separately from SNF and IRF patients may be warranted, and such a model is pursued further in Section 11.

10.5.3 Summary of Section 10.5 Models

The major conclusions from this part of the analysis are the following.

- There is some evidence to suggest the future development of a common payment system for the three inpatient PAC settings (IRF, LTCH, and SNF). This is especially true of within-sample performance for the routine RII model. Clinical information alone, without setting information, can predict between 65 and 70 percent of variation in the routine RII. Including setting information improves this performance only marginally.

- The performance of the therapy models lags behind the performance of the routine nursing models, even when using the regression tree modeling algorithms to choose explanatory variables in an optimal way and allowing for the complex interactions that such modeling creates.

- The results illustrated in the regression trees indicate the further investigation of a model composed of the following three components: an HHA-specific model, an LTCH-specific model, and a combined SNF/IRF model.

10.6 Substitutability among Variables in Explaining RI

Certain of the variables used in the CART models can be substituted for one another based upon their high correlations with one another and their potential use as surrogates for one another in the CART analyses. A surrogate is a variable that would be chosen to assign a patient to one of the two child nodes if the main splitting variable were missing for that patient. Some examples follow.

- The Rasch self-care and mobility scores are highly substitutable. The correlation between the two variables across all settings is slightly greater than 0.80. Also, for practically all self-care splits, the mobility score acts as the top surrogate. The mobility score also is usually a top competitor in those nodes that split on the self-care score. Likewise, the self-care score usually acts as a surrogate and top competitor to the mobility score. In light of these findings, the mobility and self-care scores are combined into a motor function score in the regression analyses in Section 11.

- A primary diagnosis of ventilator and tracheostomy (vent/trach) can be substituted for ventilator therapy. In the LTCH routine RII model, those patients with ICU stays of fewer than 64 days (almost all of the LTCH patients) are split on whether they received ventilator therapy at the LTCH. It turns out that there is a high correlation (0.71) between the vent/trach primary diagnosis from the acute stay and LTCH-provided ventilator therapy. For the split described above, the vent/trach primary diagnosis serves as the top surrogate and top competitor. Given this high correlation, in the regression analyses in Section 11 the patients with a vent/trach primary diagnosis are redefined as having a respiratory surgical diagnosis, and ventilator use remains in the model.

- Significant ICU stays and high values of the comorbidity index can be substituted for the LTCH setting indicator.

- There is some substitutability between the Rasch scores and the comorbidity index, but it is not as pronounced as the substitutability between the two Rasch scores.

10.7 Additional Suggested Changes for New Regressions

The CART models have suggested changes to be made in the regression approach. The CART models suggested which variables were of importance in the various settings and for the medical condition strata. We can see which variables are reasonable substitutes for one another, especially when the setting markers are removed. They are limited, however, as final models because the technique of repeatedly splitting groups produces final nodes that are often quite small given the available sample size. The robustness of the averages found for the finer splits is questionable if projected to the larger population.

More specifically, in the earlier models the number of ICU days in the short-term acute hospital was included as an indicator variable equal to 1 if the number of days in the ICU before PAC admission was greater than 7. The CART analysis indicated that another approach would be to include the variable as a continuous linear variable and also to include the square of the variable to allow for an increasing or decreasing effect of changes in the variable, depending on whether the variable was large or small. For example, the effect of an additional ICU day, going from 3 to 4, would affect resource use differently than an additional day going from 8 to 9. Linear and squared terms were included for ICU days, comorbidity index, and the functional measure of motor score. The effect of a change in each of these variables is allowed to differ across various levels of each variable.

Another change suggested by the CART analysis was the addition of an overall comorbidity index in addition to the HCC comorbidity groups. This measure was built from the underlying HCCs and came from the type of risk models used to predict Medicare expenditures (see Section 5). Terms for this variable and its square were tested in the new models.

In the next section, we return to the regression approach as modified by findings in this section.

Table 10-1
Important determinants of the routine resource intensity index by setting, CART model results

HHA Model	Score	LTCH Model	Score
Hemodialysis	100.0	ICU Days	100.0
Rasch Mobility Score	11.1	Ventilator	29.1
Rasch Self-Care Score	7.0	Prim DX: Vent/Tracheostomy	25.2
Comorbidity Index	6.6	No Intake by Mouth	21.6
Major Wound	5.2	Rasch Self-Care Score	17.3
Prim DX: Ortho Maj Surgical	3.4	Rasch Mobility Score	12.1
Sitting Endurance	1.3	Comorbidity Index	12.0
Age	1.3	Age	8.2
Comorb DX: Head/Spine	1.2	Prim DX: Septicemia	6.9
Prim DX: COPD	1.2	Pressure Ulcer	3.8
SNF Model	**Score**	**IRF Model**	**Score**
Rasch Mobility Score	100.0	Comorb DX: Head/Spine	100.0
Rasch Self-Care Score	86.4	Rasch Self-Care Score	92.5
Comorbidity Index	80.9	Rasch Mobility Score	77.6
Sitting Endurance	44.6	Comorbidity Index	67.9
Cognitive Function	16.5	Age	59.3
Expression	12.8	No Intake by Mouth	51.2
Age	11.2	Sitting Endurance	48.1
Prim DX: Ortho Maj Medical	7.8	Bowel Incontinence	29.1
Prim DX: Ortho Maj Surgical	6.1	Prim DX: Neurologic Surgical	28.5
Comorb DX: Cellulitis	5.0	Expression	25.7
Bowel Incontinence	5.0	Bowel Catheter	24.2
Prim DX: Kidney Medical	5.0	Bladder Incontinence	16.9
—	—	Swallowing Symptoms	16.6

NOTE: “Score” indicates the relative importance of each variable in explaining variation in resource intensity. The score is equal to 100 for the most important explanatory variable. The score for each of the other variables indicates how important it is relative to the most important variable. COPD = chronic obstructive pulmonary disease; CRU = cost and resource utilization; DX = diagnosis; HHA = home health agency; ICU = intensive care unit; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU collection forms, limited to stays/episodes where patient was discharged from the acute inpatient setting within 100 days of the PAC admission.

Table 10-2
Important determinants of the routine resource intensity index by diagnostic group, CART model results

Med/Surg Model	Score	Neurological Model	Score
ICU Days	100.0	Rasch Self-Care Score	100.0
Comorbidity Index	33.6	Rasch Mobility Score	76.4
Rasch Mobility Score	27.8	Comorbidity Index	62.8
Rasch Self-Care Score	23.2	Sitting Endurance	39.2
Central Line Management	20.9	Age	30.3
Age	12.7	Comorb DX: Orthopedic	25.3
Major Wound	11.7	Expression	20.1
Comorb DX: Cardiovascular	11.2	Bowel Incontinence	19.0
Sitting Endurance	10.1	Comorb DX: Urinary Infection	17.2
Comorb DX: Orthopedic	9.2	Comorb DX: GI and Liver	11.0
No Intake by Mouth	8.7	Bladder Incontinence	10.9
Bowel Incontinence	7.8	Comorb DX: Respiratory	9.2
Pressure Ulcer	6.6	Comorb DX: Metabolic	8.8
Orthopedic Model	**Score**	**Respiratory Model**	**Score**
Comorbidity Index	100.0	ICU Days	100.0
Rasch Mobility Score	85.1	No Intake by Mouth	58.8
Rasch Self-Care Score	81.6	Prim DX: Vent/Tracheostomy	55.3
Central Line Management	40.0	Ventilator	50.0
Pressure Ulcer	27.9	Rasch Self-Care Score	43.3
Bladder Incontinence	27.5	Comorbidity Index	30.1
ICU Days	21.2	Central Line Management	26.6
Cognitive Function	19.7	Rasch Mobility Score	12.0
Bowel Incontinence	16.9	Age	11.1
Prim Dx: Ortho Maj Surgical	14.5	Total Perenteral Nutrition	6.4
Hemodialysis	14.3	Bowel Incontinence	5.1
Age	12.0	Comorb DX: Renal	4.0
Sitting Endurance	8.5	Comorb DX: Orthopedic	2.7

NOTE: “Score” indicates the relative importance of each variable in explaining variation in resource intensity. The score is equal to 100 for the most important explanatory variable. The score for each of the other variables indicates how important it is relative to the most important variable. CRU = cost and resource utilization; DX = diagnosis; ICU = intensive care unit; Med/Surg = medical and surgical primary diagnoses.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU collection forms, limited to stays/episodes where patient was discharged from the acute inpatient setting within 100 days of the PAC admission.

Table 10-3
Important determinants of the therapy resource intensity index by setting, CART model results

HHA Model	Score	LTCH Model	Score
Rasch Self-Care Score	100.0	Age	100.0
Rasch Mobility Score	90.4	Prim DX: Vent/Tracheostomy	94.4
Prim DX: Stroke	32.3	Rasch Self-Care Score	94.2
Prim DX: Ortho Maj Surgical	32.1	Rasch Mobility Score	73.4
Age	13.6	No Intake by Mouth	64.8
Comorbidity Index	13.1	Ventilator	64.7
Comorb DX: Stroke	11.1	ICU Days	57.8
Prim DX: Cardio-Surgical	10.3	Comorbidity Index	48.2
Respiratory Status Impaired	10.2	Sitting Endurance	35.2
Comorb DX: Orthopedic	9.1	Comorb DX: Cellulitis	34.6
Prim DX: Neurologic Surgical	9.0	Major Wound	29.0
Cognitive Function	8.7	Comorb DX: Cardiovascular	25.2
Swallowing Symptoms	8.0	Bowel Incontinence	21.9
SNF Model	Score	IRF Model	Score
Rasch Mobility Score	100.0	Rasch Self-Care Score	100.0
Rasch Self-Care Score	77.5	Comorbidity Index	98.3
Comorbidity Index	58.8	Rasch Mobility Score	86.8
Age	50.3	Sitting Endurance	74.8
Expression	32.9	Comorb DX: Stroke	65.7
Comorb DX: GI and Liver	25.8	Prim DX: Stroke	59.0
Prim DX: Ortho Maj Surgical	25.3	Age	56.3
Comorb DX: Respiratory	14.6	Expression	38.2
Bladder Incontinence	13.2	Comorb DX: Cardiovascular	21.9
Cognitive Function	13.1	Comorb DX: Head/Spine	21.7
Swallowing Symptoms	12.3	Comorb DX: Orthopedic	21.2
Prim DX: Ortho Min Medical	12.1	No Intake by Mouth	20.2
Prim DX: Ortho Maj Medical	10.5	Pressure Ulcer	18.5

NOTE: "Score" indicates the relative importance of each variable in explaining variation in resource intensity. The score is equal to 100 for the most important explanatory variable. The score for each of the other variables indicates how important it is relative to the most important variable. CRU = cost and resource utilization; DX = diagnosis; HHA = home health agency; ICU = intensive care unit; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU collection forms, limited to stays/episodes where patient was discharged from the acute inpatient setting within 100 days of the PAC admission.

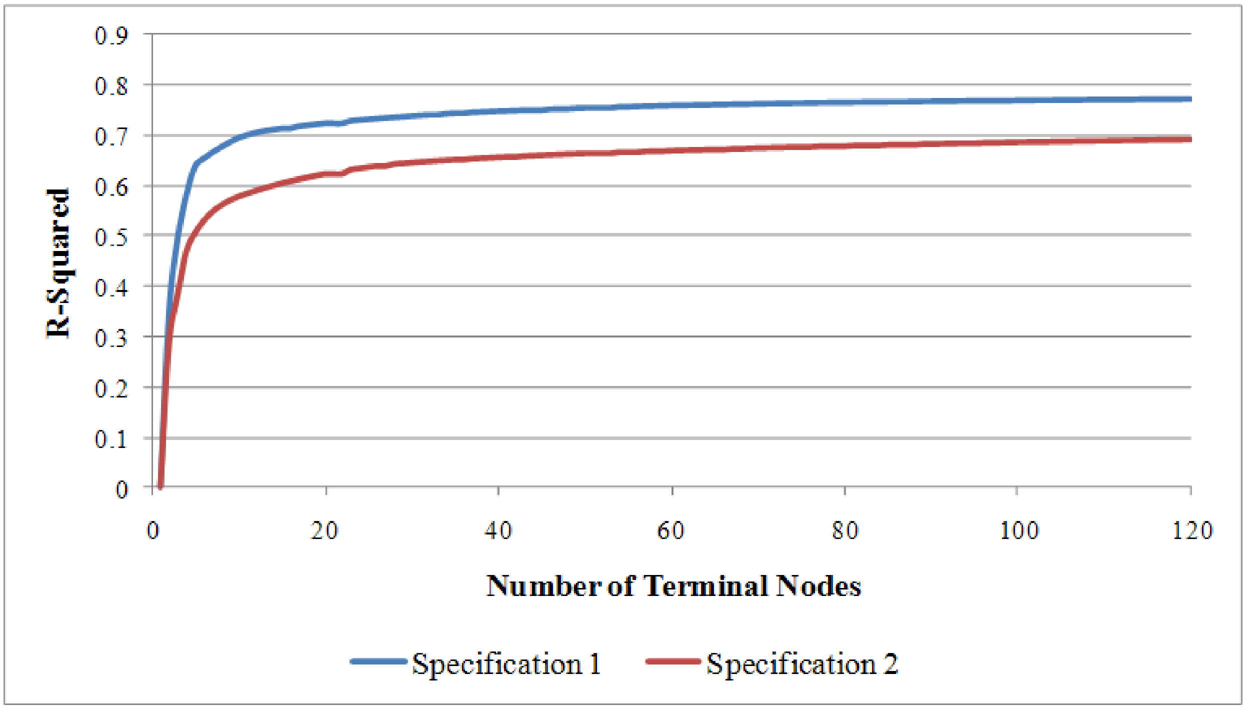
Table 10-4
Important determinants of the therapy resource intensity index by diagnostic group, CART model results

Med/Surg Model	Score	Neurological Model	Score
Comorbidity Index	100.00	Rasch Self-Care Score	100.00
Rasch Self-Care Score	64.53	Rasch Mobility Score	85.06
Rasch Mobility Score	59.9	Comorbidity Index	79.28
Age	59.88	Age	60.99
Acute Stay Past 2 Months	32.06	Sitting Endurance	24.23
Cognitive Function	22.6	Comorb DX: Stroke	19.74
Bowel Incontinence	17.72	Comorb DX: UTI	18.94
Comorb DX: Respiratory	17.54	Cognitive Function	18.47
Prim DX: Endocrine Medical	13.73	Swallowing Symptoms	14.7
Comorb DX: Metabolic	12.11	Central Line Mgmt	11.34
Sitting Endurance	12.08	Comorb DX: Orthopedic	10.7
Central Line Mgmt	10.26	Bowel Incontinence	9.99
Comorb DX: GI and Liver	9.46	Prim DX: Stroke	8.98
Orthopedic Model	Score	Respiratory Model	Score
Rasch Self-Care Score	100.00	Age	100.00
Rasch Mobility Score	98.86	Comorbidity Index	79.81
Comorbidity Index	77.97	Rasch Mobility Score	74.63
Age	45.41	Rasch Self-Care Score	73.25
Expression	43.94	Comorb DX: GI and Liver	48.71
Cognitive Function	31.48	Prim DX: Vent/Tracheostomy	46.65
Sitting Endurance	28.33	Comorb DX: Stroke	34.97
Comorb DX: Stroke	18.67	No Intake by Mouth	33.8
Prim DX: Ortho Maj Surgical	15.61	Comorb DX: Cardiovascular	32.4
Prim DX: Ortho Min Surgical	15.24	Expression	22.27
Prim DX: Ortho-Head/Spine	12.27	Bladder Incontinence	20.19
Bladder Incontinence	8.35	Ventilator	16.92
Comorb DX: Metabolic	6.51	ICU Days	13.55
Comorb DX: Orthopedic	5.38	Cognitive Function	13.08

NOTE: "Score" indicates the relative importance of each variable in explaining variation in resource intensity. The score is equal to 100 for the most important explanatory variable. The score for each of the other variables indicates how important it is relative to the most important variable. CRU = cost and resource utilization; DX = diagnosis; ICU = intensive care unit; Med/Surg = medical and surgical primary diagnoses.

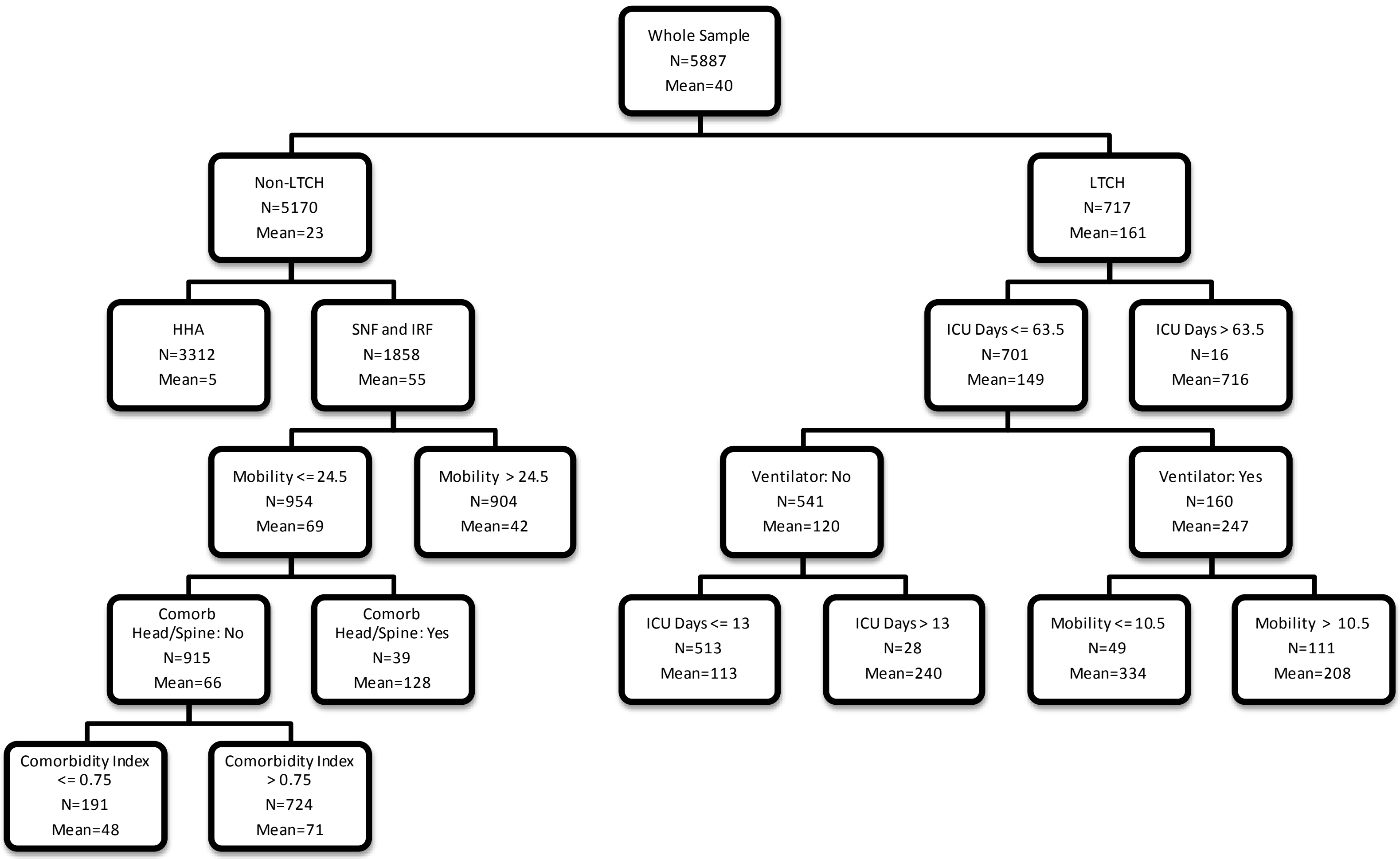
SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU collection forms, limited to stays/episodes where patient was discharged from the acute inpatient setting within 100 days of the PAC admission.

Figure 10-1
Comparing the goodness of fit for the routine resource intensity index CART models, all settings with and without setting indicators (specifications 1 and 2)



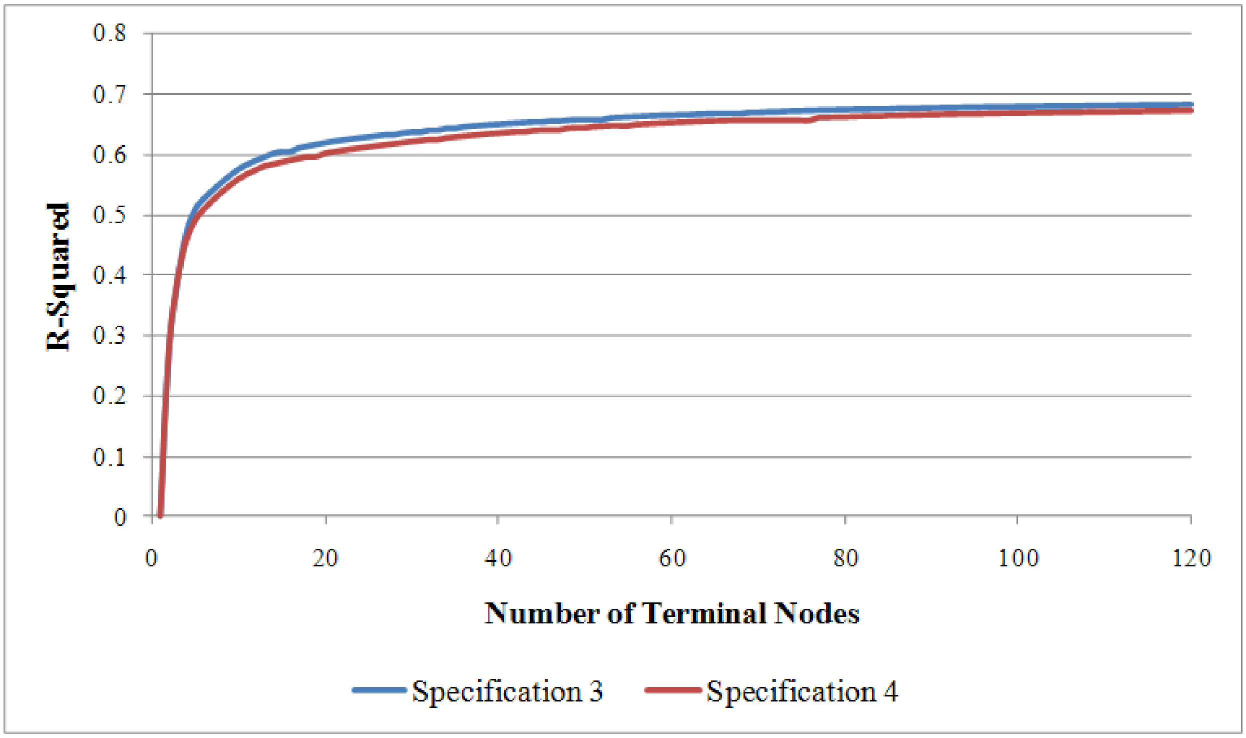
SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU collection forms, limited to stays/episodes where patient was discharged from the acute inpatient setting within 100 days of the PAC admission.

Figure 10-2
Regression tree for the routine resource intensity index, all settings with setting indicators (specification 1)



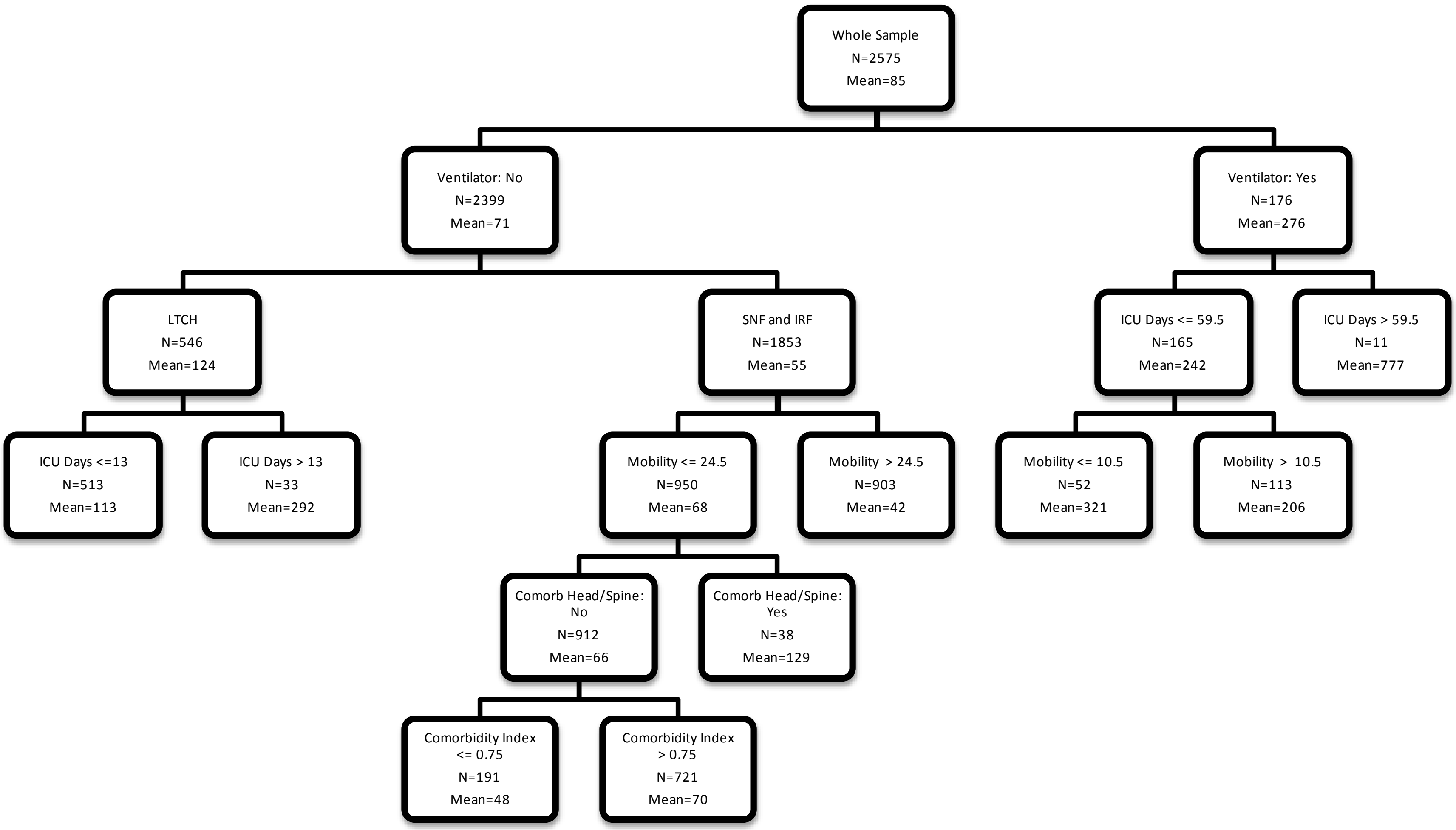
SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU collection forms, limited to stays/episodes where patient was discharged from the acute inpatient setting within 100 days of the PAC admission.

Figure 10-3
Comparing the goodness of fit for the routine resource intensity index CART models, inpatient PAC settings, with and without setting indicators (specifications 3 and 4)



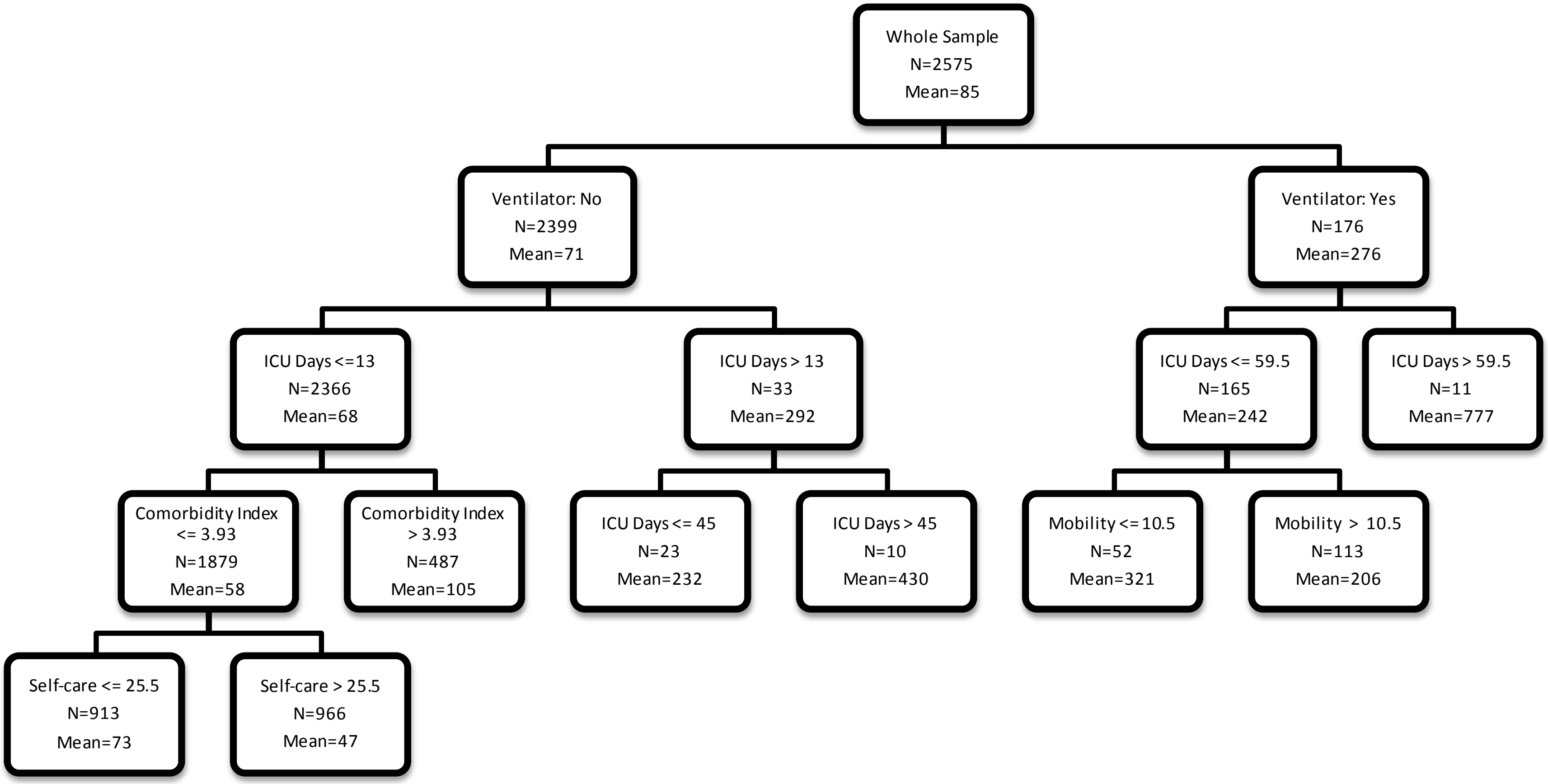
SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU collection forms, limited to stays/episodes where patient was discharged from the acute inpatient setting within 100 days of the PAC admission.

Figure 10-4
Regression tree for the routine resource intensity index, inpatient PAC settings, with setting indicators (specification 3)



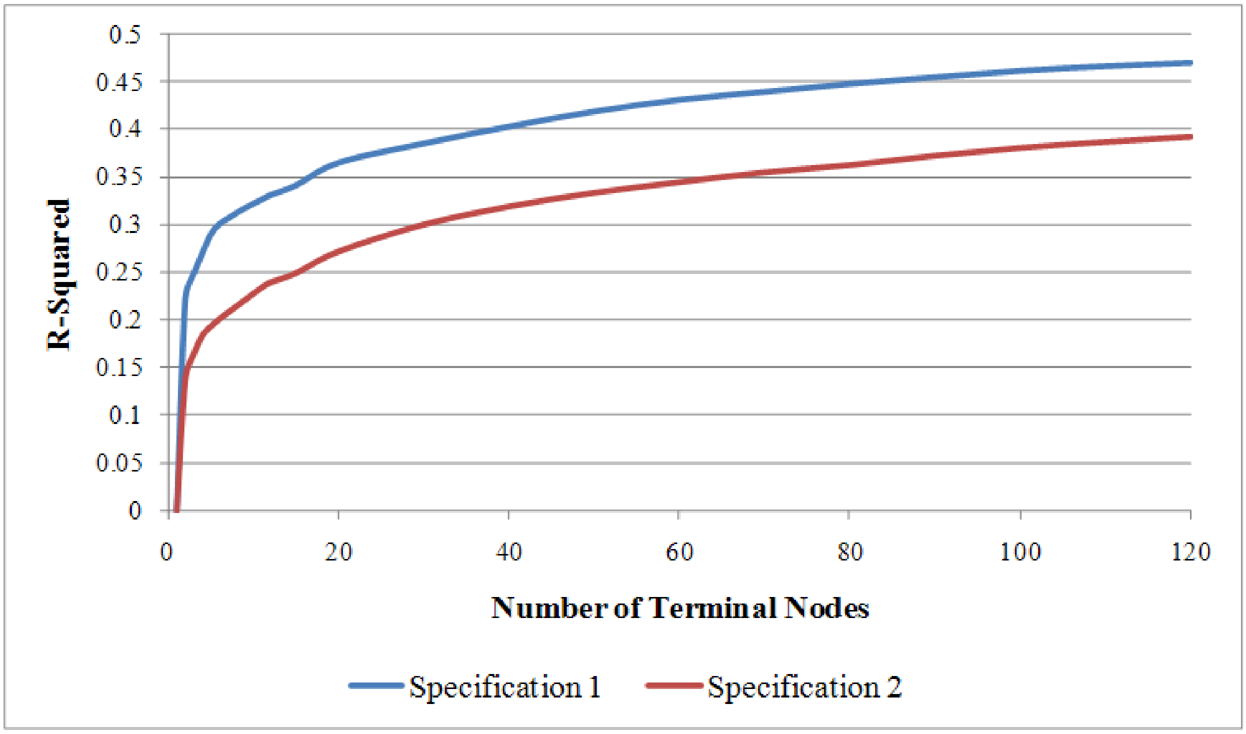
SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU collection forms, limited to stays/episodes where patient was discharged from the acute inpatient setting within 100 days of the PAC admission.

Figure 10-5
Regression tree for the routine resource intensity index, inpatient PAC settings, without setting indicators (specification 4)



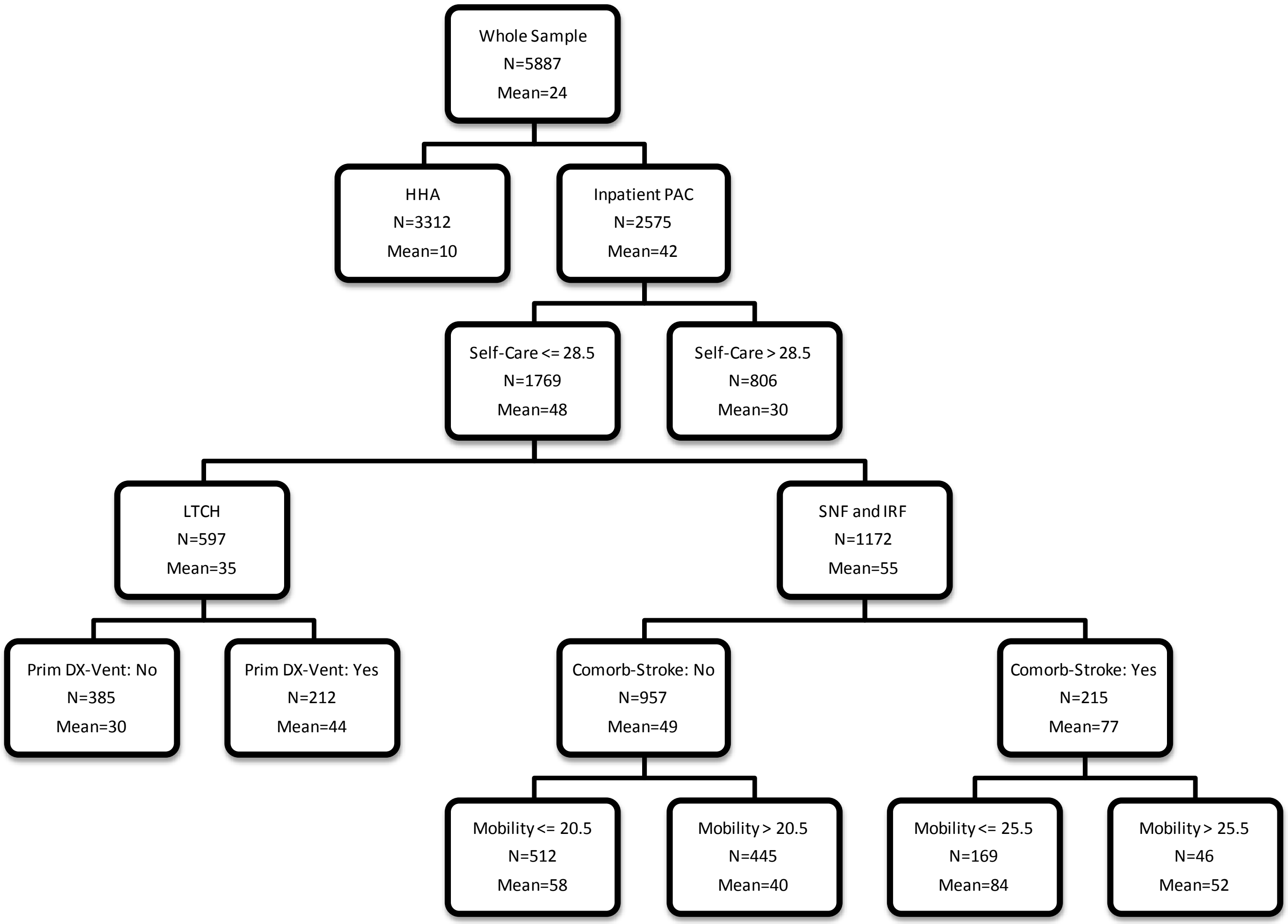
SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU collection forms, limited to stays/episodes where patient was discharged from the acute inpatient setting within 100 days of the PAC admission.

Figure 10-6
Comparing the goodness of fit for the therapy resource intensity index CART models, all settings with and without setting indicators (specifications 1 and 2)



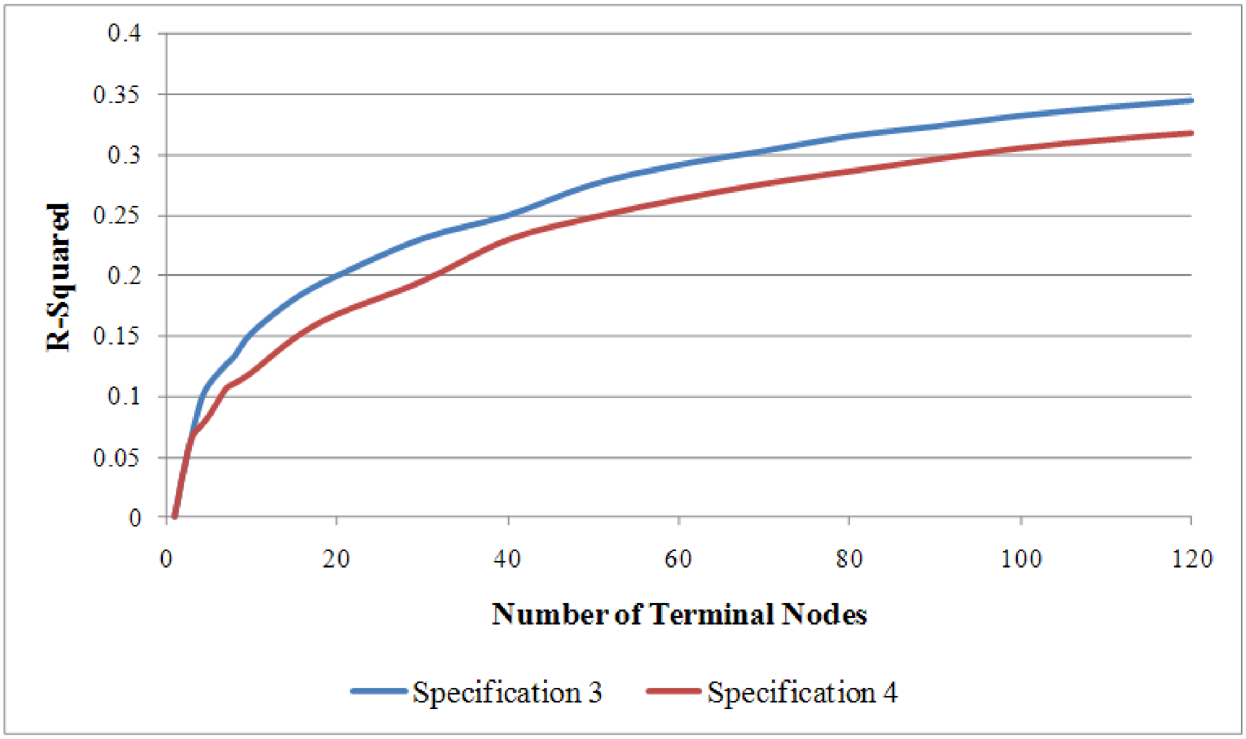
SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU collection forms, limited to stays/episodes where patient was discharged from the acute inpatient setting within 100 days of the PAC admission.

Figure 10-7
Regression tree for the therapy resource intensity index, all settings with setting indicators (specification 1)



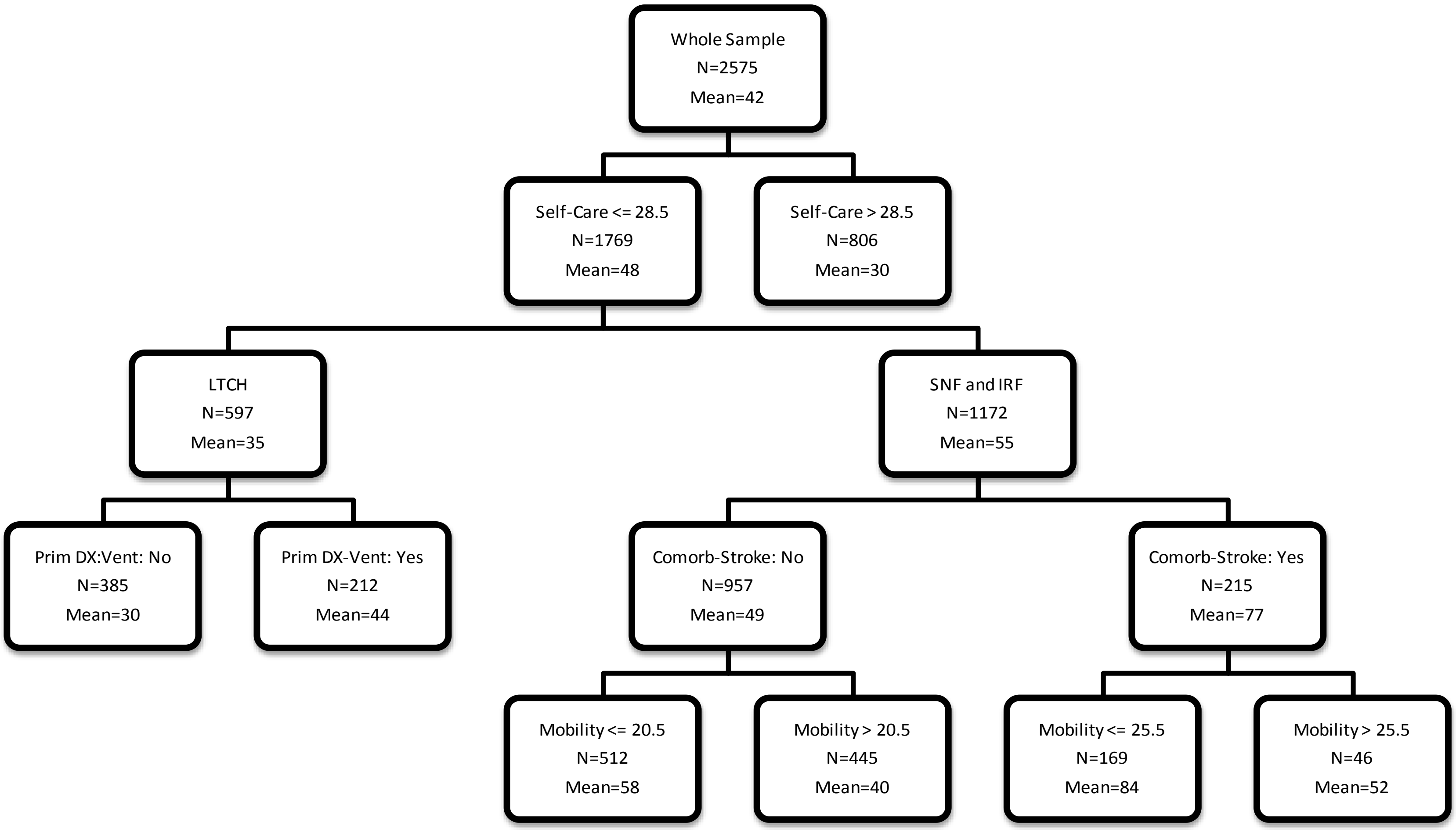
SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU collection forms, limited to stays/episodes where patient was discharged from the acute inpatient setting within 100 days of the PAC admission.

Figure 10-8
Comparing the goodness of fit for the therapy resource intensity index CART models, inpatient PAC settings, with and without setting indicators (specifications 3 and 4)



SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU collection forms, limited to stays/episodes where patient was discharged from the acute inpatient setting within 100 days of the PAC admission.

Figure 10-9
Regression tree for the therapy resource intensity index, inpatient PAC settings, with setting indicators (specification 3)



SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU collection forms, limited to stays/episodes where patient was discharged from the acute inpatient setting within 100 days of the PAC admission.

SECTION 11
DETERMINANTS OF RESOURCE INTENSITY: MULTIVARIATE REGRESSION RESULTS

11.1 Introduction

The work reported in the prior chapters has explored a number of ways to evaluate factors to be used in models that predict the resource intensity index (RII). We have also explored the implications of creating models specifically for different post-acute care (PAC) settings and, in the classification and regression tree (CART) modeling, different clinical strata of patients. In this chapter we return to a regression approach and synthesize the new information from the CART analyses in new re-specified regression models.

As discussed in Section 10, the exploratory CART analyses suggested possible refinements to the models used in the analyses from the Interim Report. For example, the CART analyses provided information on how certain patient acuity measures could be more effectively entered in the regression models. Evidence from the CART analyses was used to suggest several types of changes to the previous models. First, it suggested the inclusion of different variables beyond those included previously. For example, the results suggested that a comorbidity index be included in addition to the comorbidity indicators. Second, the results suggested different approaches regarding how continuous variables such as functional status and time in the intensive care unit (ICU) should be entered into the model and how the effect of these measures on the RII differ at various levels of these measures. Third, the results suggested strategies for addressing colinearity among the patient acuity measures used as explanatory variables and how these measures interact with one another in the prediction of the routine and therapy RIIs.

Another change was to examine two additional model approaches. The first additional approach comprises three main components: (1) a setting-specific home health agency (HHA) component, (2) a setting-specific long-term care hospital (LTCH) component, and (3) a combined skilled nursing facility (SNF)/inpatient rehabilitation facility (IRF) component. The second additional approach is to model four clinical strata: neurological, orthopedic, respiratory, and other medical and surgical conditions. These models offer an alternative to a model spanning all inpatient PAC settings and conditions while not going as far as setting-specific models that incorporate all the idiosyncrasies of each setting. Thus, the results in this section relate to the following five models.

- **All-PAC Settings.** This type of model estimates a single set of case-mix weights and a single base resource intensity amount for all PAC settings (HHA, IRF, LTCH, and SNF). This model predicts the intensity and amount of care for a given patient forcing the effects of the patient characteristics on intensity to be uniform across all settings.

  The All-PAC Settings models are composed of two components: (1) a component predicting whether services are used and (2) a component predicting the amount of services used if positive.

- **HHA–Inpatient PAC Settings.** This pair of models is the same as the previous model, but it separates HHAs from inpatient PAC settings on the observation that home health resource intensity structures are significantly different based on the fewer hours of services being provided in the home. This type of model allows the effects of patient characteristics on intensity in the HHA setting to be different from the effects of patient characteristics in the remaining settings. The effects of the patient characteristics on intensity are forced to be uniform across three inpatient PAC settings (IRF, LTCH, and SNF).

The HHA–Inpatient PAC Settings models are composed of three components: (1) an HHA-only component predicting whether services are used; (2) an HHA-only component predicting the amount of services used if positive; and (3) an inpatient PAC-only component predicting the amount of services used (since all inpatient PAC patients received at least some routine and therapy services).

- **HHA–LTCH–SNF/IRF.** This set of models allows the effects of patient characteristics on intensity in the HHA and LTCH settings to be unique to each of these individual settings. The effects of patient characteristics on intensity in the SNF and IRF settings are not allowed to differ from one another.

  The HHA–LTCH–SNF/IRF models are composed of four components: (1) an HHA-only component predicting whether services are used; (2) an HHA-only component predicting the amount of services used if positive; (3) an LTCH-only component predicting the amount of services used; and (4) an combined SNF and IRF component predicting the amount of services used.

- **HHA–Inpatient Diagnostic Groups.** This set of models allows the effects of patient characteristics on intensity in the HHA setting to be different from the effects of patient characteristics in the remaining settings. In addition, for the patients admitted to IRFs, LTCHs, and SNFs, it allows the effects of patient characteristics on intensity to vary across the following four broad diagnostic groups: neurological, orthopedic, respiratory, and medical/surgical conditions not otherwise categorized. The distributions of the routine and therapy RIIs for inpatient PAC patients by diagnostic group are provided in **Tables 11-1** and **11-2**. The equivalent descriptive statistics by settings were presented in **Table 9-8** and **Table 9-16**.

  The HHA–Inpatient Diagnostic Groups models are composed of six components: (1) an HHA-only component predicting whether services are used; (2) an HHA-only component predicting the amount of services used if positive; (3-6) separate inpatient PAC-only components predicting the amount of services used for neurologic patients, orthopedic patients, respiratory patients, and patients with other medical/surgical primary diagnoses.

- **Setting-Specific.** This set of models allows each PAC setting to have its own set of case-mix weights and base resource intensity amount. The Setting-Specific models use consistent measures of patient acuity for each of the different settings, but this model is different from the other two models in that it allows the significance and impact of each measure to differ by setting.

Setting-Specific models are composed of five components: (1) an HHA-only component predicting whether services are used; (2) an HHA-only component predicting the amount of services used if positive; and (3-5) separate IRF-, LTCH-, and SNF-specific components predicting the amount of services used (since all inpatient PAC patients received at least some routine and therapy services).

The models were estimated in two different ways. The first way, in parallel to the work in the interim report, was to allow the data to be weighted according to the number of cases in each setting in the sample. In this way there are enough cases in each setting to capture the characteristics of patients and care patterns. To examine the effect of weighting, we reweighted the cases for each setting by the proportion of such cases in the national patient population. This is a logical weighting approach that would allow the combined models to make better predictions for most of the patients, but not necessarily the best predictions for each setting. For example, in this study LTCH and IRF patients were both oversampled relative to SNF patients. To the extent that different factors predict the RII in each setting, using a combined model would lead to a less than optimal prediction of the RII for SNF patients, although they make up the majority of patients in inpatient PAC settings. Providing greater weight to the SNF observations in the sample in effect creates a combined model that is closer to a SNF-specific model and that would provide better prediction of the RII for SNF patients, who make up a large proportion of PAC stays. The predictions for patients in the other settings may suffer, however.

The sample used to estimate these models is the same as that used in the analysis reported in Section 9. It includes stays/episodes for which there was no immediately prior index acute inpatient stay. Because there is no comorbidity index created for these observations, an indicator variable was included in place of the missing index. The HHA sample used in this analysis includes only the episodes with CARE assessment information at the start of the episode. Thus, if a patient had an uninterrupted string of HHA episodes within a participating agency, only the first episode would be represented in the sample.

The sections below provide a description of the results and implications of these new models and discuss the advantages and disadvantages of each approach. The discussion concentrates first on the sample-weighted models and then moves on to the population-weighted models.

11.2 Routine RII Results

In this section, we discuss the multivariate regression results predicting the episode/stay level routine RII across the various PAC settings. The section begins with a summary of the results regarding model setting specificity. The section concludes with a more detailed description of the results of the models that were estimated. As before, there is a concentration on the explanatory power of all models in each setting because the payment system currently in place is setting-specific.

11.2.1 Summary Statistics for the Routine RII Models across Settings

This section presents some of the summary statistics for the five classes of models used to examine the routine RII and the relative strengths of the approaches. The discussion in this section refers to three tables: **Table 11-3** through **Table 11-5**.

Table 11-3 presents the mean square error (MSE)-based R-squareds for the five model variations that were estimated. The global R-squared is in the first data column. This is a measure of how much of the total variation in the routine RII across all PAC stays/episodes was explained by each of the five models described above. The next four columns provide measures of how much of the total variation in the routine RII within each setting was explained by each model. The sixth column provides a measure of how much of the total variation in the routine RII across all inpatient PAC stays was explained by each model. The seventh column provides a measure of how much of the total variation in the RII across all SNF and IRF stays was explained by the SNF/IRF model. Finally, the last four columns provide measures of how much of the variation in the routine RII within the diagnostic groups was explained by the HHA–Inpatient Diagnostic Groups model.

In order to look at how models fit the observed data for particular subgroups, such as individual settings in the All-PAC Settings model, MSE-based R-squared statistics have to be constructed. Consider the case of using results from the All-PAC Settings model to generate an MSE-based R-squared for SNF stays. First, for the SNF stays the overall variation of the RII around the SNF-specific mean has to be determined. This measure, the sum of the squared differences between the observed values and the mean, is called the total sum of squares (TSS) by statisticians.

Once the TSS is determined, it needs to be compared to the remaining error inherent in using the multivariate model results to predict resource intensity. This measure of remaining error is known as the residual sum of squares (RSS) and can be constructed using the following steps. First, the All-Setting model results are used to predict the value of the resource intensity measure for each SNF observation. Second, the actual value of the resource intensity measure is subtracted from the predicted value for each SNF observation; this value is the residual. Third, the residual value for each of the SNF observations is squared. Finally, squared residuals are summed up across all of the SNF observations.

Once the TSS and RSS have been obtained, the MSE-based R-squared can be calculated as follows.

$$\text{MSE-based R-square} = 1 - (\text{RSS}/\text{TSS})$$

In some cases where the fit is particularly bad for a setting, the MSE-based R-squared can be negative, indicating that taking a simple setting-specific sample mean would be preferable to using the current model to predict resource intensity for patients in that setting.

Table 11-4 presents the predicted-to-actual ratios by setting for each of the five model variations that were estimated. A predicted-to-actual ratio of 1.0 indicates that a model, on average, provides unbiased predictions of the routine RII for a particular setting. Deviations from 1.0 indicate that the model either over predicts (if the ratio is greater than 1) or under predicts (if the ratio is less than 1) the routine RII.

Table 11-5 presents how the global MSE-based R-squareds for each of the five models change when additional setting indicators are included. The first column gives the global R-squared for models that include only setting indicators. The second column reproduces the results from the first column of **Table 11-3**. The final column presents the R-squared for the models that included the additional setting indicators. For the All-PAC Settings model, indicators are included for three of the PAC Settings (SNF is the omitted or reference group). For the HHA–Inpatient PAC Settings model, indicators are included for two of the inpatient PAC settings (LTCH and IRF) in the inpatient PAC-only component (SNF is the omitted or reference group). For the HHA–LTCH–SNF/IRF model, an IRF setting indicator is added to the SNF/IRF-only component (SNF is the omitted or reference group). Finally, for the HHA–Inpatient Diagnostic Groups model, setting indicators for LTCH and IRF are included in the four inpatient PAC-only components (again, SNF is the omitted or reference group).

11.2.1.1 The All-PAC Settings Model

The All-PAC Settings model is the most restrictive in that it forces patient characteristics to have the same effect on the routine RII regardless of setting or diagnosis. Thus, it is not surprising that the global R-squared for this model is the lowest among the five models being compared (see **Table 11-3**). This indicates that the model has the least power in explaining variation in the routine RII across all settings. The model does a particularly poor job at explaining variation in the routine RII for HHA episodes and SNF stays (the MSE-based R-squared is negative for HHA episodes and less than 0.10 for SNF stays). The negative value for the MSE-based R-squared for the HHA episodes indicates that simply taking the sample mean of the routine RII for the HHA episodes would be a better strategy for predicting the routine RII for HHA patients than applying the results of the All-PAC Settings model to each HHA patient's characteristics.

The negative values for some of the R-squareds are related to the way they are computed. While it is true that for any linear model, the R-squared has to lie between 0 and 1, it is possible for an R-squared that is constructed using the results of the model for a portion of the estimation sample to be negative. In this case, the average value of the routine RII for HHA episodes is a full order of magnitude lower than for SNF and IRF stays, and roughly 30 times smaller than the average routine RII for LTCH stays. A model that includes the inpatient PAC observations along with the HHA observations may over predict the routine RII for HHA episodes to such an extent that the MSE-based R-squared for this subgroup would be forced negative (because the prediction error would be extremely high).

This is borne out in the results for prediction bias by setting. The All-PAC Settings model also provides fairly biased predictions for the routine RII across all settings (see **Table 11-4**), but the bias is most pronounced for HHAs. Here the model, on average, predicts a routine RII that is 3 times greater than the actual value in this setting. At the same time, the model under predicts the routine RII in the three inpatient PAC settings. It under predicts routine RII by more than 25 percent in SNFs and by roughly 17 percent in IRFs and LTCHs.

The results presented in **Table 11-5** suggest that there are systematic differences between settings remaining after controlling for patient acuity in the All-PAC Settings model. The All-PAC Setting model estimated with only setting indicators features a global R-squared of 0.448. This type of model predicts resources based only on setting and has no controls for patient characteristics. In contrast, the R-squared for the All-PAC Settings model with patient acuity measures but without setting indicators rises to 0.683. Including both patient acuity and setting indicators in the All-PAC Setting model increases the R-squared to 0.753. This difference in the

R-squareds is significant and indicates that setting indicators would still play an important role in predicting the routine RII in the All-PAC Settings model, even after controlling for patient characteristics. Notably, in the All-PAC Setting model that includes setting indicators, the indicator for an HHA setting is highly significant and less than 1.0. This finding suggests that payment adjustors for HHAs would need to be based on a significantly lower base rate than for other settings, even after case-mix adjustment.

11.2.1.2 HHA–Inpatient PAC Settings Model

Modeling HHA episodes separately from inpatient PAC stays improves the fit of the overall model significantly (see **Table 11-3**). The global R-squared increases from 0.683 to 0.745.[18] The R-squareds for each of the individual settings also improve. For example, the R-squared increases from a negative number to 0.141 for HHA episodes and it improves from 0.033 to 0.093 for SNF stays. The fit for all inpatient PAC stays also improves from 0.606 to 0.648.

The HHA–Inpatient PAC Settings model also provides much less biased predictions of the routine RII across all settings (see **Table 11-4**). Because HHA episodes are being modeled separately, the predictions for the routine RII are unbiased for this setting. The bias in the other three settings is never greater than 10 percent. For instance, the model over predicts the routine RII by 9.4 percent for IRF stays and by 7.7 percent for SNF stays. The model under predicts the routine RII in LTCHs by roughly 8 percent.

The inclusion of setting indicators in the HHA–Inpatient PAC Settings model increases the global R-squared by only 0.009 from 0.745 to 0.754 (see **Table 11-5**). Thus, the setting factors explain very little beyond the case-mix factors, suggesting that separating HHAs from the inpatient PAC settings dramatically improved the explanatory power of the models without the need for additional setting indicators.

11.2.1.3 HHA–LTCH–SNF/IRF Model

The next model removes the restriction that patient acuity measures have the same effects on the routine RII in LTCHs as they do in the other two inpatient PAC settings. In this case separate models are estimated for HHA episodes and LTCH stays, while SNF and IRF stays are combined in one model. Again, removing the restriction slightly improves the fit of the overall model, this time from 0.745 to 0.769 (see **Table 11-3**). The fit for IRF and SNF stays improves dramatically. For IRFs the R-squared increases from 0.249 to 0.381. The R-squared for the SNF stays more than doubles from 0.093 to 0.223. The fit for all inpatient PAC stays also improves slightly from 0.648 to 0.682.

The HHA–LTCH–SNF/IRF model also improves the predicted-to-actual ratios (see **Table 11-4**). Because LTCH stays are being modeled separately, the predictions for the routine RII are unbiased for this setting. But the predicted-to-actual ratio also improves significantly for the IRFs, falling from 1.094 to 1.016. The predicted routine RII is also less biased for SNF stays, as the model predicts routine RII that, on average, is 2.5 percent less than the actual. In the

[18] This result is very similar to the one reported in the Interim Report, where the R-squared increased from 0.636 to 0.704.

HHA–Inpatient PAC Settings model, the predictions were, on average, 7.7 percent higher than the actual for SNFs. Based on the improvements in both the fit and predicted-to-actual ratios for the SNF and IRF settings, this model may be considered as a possible compromise model between the HHA–Inpatient PAC Settings and Setting-Specific models. However, the fit for a particular setting is always improved when it is isolated from the others and its coefficients are customized to the existing pattern of care in the setting.

The inclusion of setting indicators in this model does not increase the global R-squared by any amount past the third decimal place (see **Table 11-5**). Thus, the additional setting factors explain nothing beyond the case-mix factors, suggesting that separating the HHAs and LTCHs from the remaining two inpatient PAC settings dramatically improved the explanatory power of the models without the need for further setting indicators.

11.2.1.4 HHA–Inpatient Diagnostic Groups Model

This model is similar to the HHA–Inpatient PAC Settings model in that it models HHA episodes separately from inpatient PAC stays. In addition, for the patients admitted to IRFs, LTCHs, and SNFs, it allows the effects of patient characteristics on the routine RII to vary across the following four broad diagnostic groups: neurological, orthopedic, respiratory, and not otherwise classified medical/surgical cases. The effects are not allowed to vary by inpatient PAC setting except insofar as the diagnostic groups are predominant in a particular setting, as is the case for many respiratory patients.

Overall, the model is an improvement over the HHA–Inpatient PAC Settings model. The R-squareds improve significantly in each inpatient PAC setting (see **Table 11-3**), from 0.249 to 0.316 for IRFs, from 0.619 to 0.699 for LTCHs, and from 0.093 to 0.180 for SNFs. The global R-squared is greater than that in the HHA–Inpatient PAC Settings model, 0.788 as compared to 0.745. Also, the predictions carry less bias than those in the HHA–Inpatient PAC Settings model (see **Table 11-4**). The predicted-to-actual ratio improves from 1.094 to 1.077 for IRFs, from 0.921 to 0.941 for LTCHs, and from 1.077 to 1.047 for SNFs.

Whether the model is statistically an improvement over the HHA–LTCH–SNF/IRF model is less clear. The global R-squared is better (0.788 as compared with 0.769), but the R-squareds are worse for the IRF and SNF stays. Additionally, the predictions of the routine RII are more biased for the IRF stays in the HHA–Inpatient Diagnostic Groups model; the predicted-to-actual ratio is 1.077 as compared with 1.016 in the HHA–LTCH–SNF/IRF model. The predictions are also more biased for the SNF stays. Finally, the improvement in the fit for LTCH stays is countered by the introduction of some bias because the LTCH does not have its own model or setting indicator.

The inclusion of setting indicators in the HHA–Inpatient Diagnostic Groups model increases the global R-squared by only 0.007 from 0.788 to 0.795 (see **Table 11-5**). Thus, the setting factors explain very little beyond the case-mix factors, suggesting that separating HHAs from the inpatient PAC settings and, for the inpatient PAC settings, allowing the effects of patient characteristics on the routine RII to vary across the four broad diagnostic groups dramatically improved the explanatory power of the model without the need for setting indicators.

11.2.1.5 Setting-Specific Model

The next model removes the restriction that patient acuity measures have the same effects on the routine RII across the inpatient PAC settings. It allows the effects of patient characteristics on the routine RII to be different in each PAC setting and also allows the base resource use (the intercept terms in the regressions) to vary across the four settings. By construction, this model provides unbiased predictions of the routine RII in each setting (see **Table 11-4**). It also improves the fit for IRFs and SNFs as compared with the HHA–Inpatient PAC and HHA–LTCH–SNF/IRF models (see **Table 11-3**). The improvement in the fit for SNF stays is substantial; the R-squared improves to 0.377 for this setting. The improvement in the fit for IRF stays is less pronounced but still significant; the R-squared rises to 0.424. The overall, or global, fit of the model (R-squared = 0.778) is only marginally better than that of the HHA–LTCH–SNF/IRF model (R-squared = 0.769).

11.2.1.6 Summary of Section 11.2.1

Both the HHA–LTCH–SNF/IRF and HHA–Inpatient Diagnostic Groups models represent improvements over the HHA–Inpatient PAC Settings model and may provide further evidence for the development of a framework for developing payment systems that minimize their setting-specific components. The HHA–Inpatient Diagnostic Groups model provides a slightly better overall fit than the Setting-Specific model but suffers from a comparatively poor fit for SNF and IRF stays. The HHA–LTCH–SNF/IRF model provides relatively unbiased predictions, but also suffers from a relatively poorer fit for SNF stays. Given that a large proportion of PAC episodes and stays are in SNFs, this poor performance for SNF stays may pose a problem.

11.2.2 Detailed Regression Results for Routine RII Models across Settings

In this section the coefficients in the various models will be discussed with indications as to the similarities and differences in the most influential variables. The models are a generalized linear model (GLM) with logarithmic link and Gaussian distribution of the level of total stay routine RII. For the first stage of the HHA models, the model is a GLM with a logistic link and a binomial distribution of the probability that the patient received any routine services. Effects of each case-mix characteristic based on the models are multiplicative factors applied to the total stay routine RII; for example, a reported effect of 1.10 implies a 10 percent increase in RII if a patient has that characteristic relative to if they do not, holding other characteristics fixed. For an indicator variable the coefficient is the multiplier for having the characteristic (variable = 1) compared to not having it (variable = 0).

In all instances, the significance of a patient acuity factor is the significance with all other factors in the model held constant. This may mean that the presence of collinear variables in the model makes the coefficient associated with a particular variable not statistically significant. At the same time, it is important to note that the impact of these factors, significant or not, has been accounted for in the models and is represented in the model summary information.

In interpreting the coefficients, the models also differ in the degree to which the model spans multiple settings. If an acuity measure is strongly associated with treatment in a particular site of care, the coefficients in a multisetting model may be influenced by the likelihood of seeing a patient in a particular setting, the overall practice patterns within a setting, and the degree to which the acuity measure impacts patient-specific RII levels within the setting. In the single-setting models, some of the indicator variables included, especially for diagnoses, have very low frequencies. In such cases, care should be taken in interpreting the results.

It should also be noted that the coefficients represent the incremental change in the RII after controlling for the other variables in the model being estimated. Correlation of explanatory variables with other variables included in the model can affect the values and significance of the coefficients.

11.2.2.1 Separate HHA and Inpatient Case-Mix Model of Total Inpatient Stay/HHA Episode Routine/Nursing Intensity

Table 11-6 presents the separate relative weights for the total HHA episode routine RII (first and second columns) and the total PAC inpatient stay routine RII (third column). As noted earlier, this model provides better predictions of the actual routine RII than the All-PAC Settings model, which combined the HHA and inpatient PAC settings. The coefficients presented in this table represent model components associated with the **HHA–Inpatient Setting Model**. In addition, the two HHA columns shown in this table will also be applicable to all models that break out HHA, which include all models examined except for the **All-Settings Model**. Note that, in these analyses, the resource intensity for the HHA population is based on the episode associated with their admission to the participating HHA and thus their CARE admission. HHA coefficients should be interpreted in light of this sample restriction.

Among the age and administrative items included in the model, age is significant only in the HHA model, where patients aged 70 to 74 who received any routine nursing care had a higher routine RII than HHA patients 85 years of age or over. Also in the HHA model, patients aged 80 to 84 were less likely to receive any routine services than patients 85 years of age or over.

Having had an acute stay in the 2 months prior to admission to the PAC site is associated with a higher probability of receiving any routine services among the HHA patients, although among patients who receive such services, the level of routine nursing intensity is slightly lower, indicating for those community admit HHA patients who require routine care, the intensity of routine care provided is relatively more intense. This variable is not significant in the inpatient PAC setting model. Longer ICU stays are associated with a higher routine RII in the inpatient PAC settings model, although the impact of this variable diminishes as ICU stays get longer. Length of ICU stay is not significant in the HHA components of the model.

Among the primary diagnoses, only a few are significant in predicting the probability of receiving any routine services in HHAs, relative to the probability that a stroke patient will receive any routine services. Among those patients who receive at least some routine services, several more of the diagnoses are significant in predicting the level of the routine RII, with most of them predicting a higher routine RII than for stroke patients. When comparing the importance of the various primary diagnoses across the HHA and inpatient PAC components, only two of the diagnoses that are significant at the 5-percent level in the HHA model are significant in the inpatient PAC model. In these two cases, having the primary diagnosis is related to a higher routine RII in the HHA model and to a lower routine RII in the inpatient PAC model. Overall, the results indicate that primary diagnosis predicts the routine RII differently in the two groupings of settings examined.

There are also differences in how the comorbid conditions predict the routine RII between the components. For instance having a cardiovascular or cellulitis comorbidity is associated with a higher routine RII in inpatient PAC settings, but is not significant in either of the HHA components. At the same time, the two neurologic comorbidities (including history of stroke) are associated with a lower routine RII among HHA patients who receive any routine services, but are not significant in the inpatient PAC component of the model.

After controlling for the other variables in the models including the comorbidity indicators, the comorbidity index is significant only in the HHA intensity component of the model where a higher index is associated with a higher routine RII. The squared term indicates that this relationship diminishes somewhat as the index increases.

Among the major treatments, total parenteral nutrition, central line management, and ventilator use are all associated with a higher routine RII in the inpatient PAC settings. This differs from their impact in HHAs, where total parenteral nutrition is associated with a lower probability of receiving any routine services and the other two treatments are not significant. Caution should be taken in interpreting this finding in the HHA setting given the very low incidence of this treatment at admission in the HHA population examined. Hemodialysis is associated with a higher routine RII in HHAs with a lower routine RII in the inpatient PAC settings. The presence of major pressure ulcers and major wounds are associated with a higher routine RII in both the use of routine services in HHA and intensity in inpatient PAC settings. Among HHA users of routine services, major wounds were associated with higher intensity but the presence of pressure ulcers was not significant.

Cognitive status is generally not a significant factor in either component of the HHA model. On the other hand, cognitive impairment is associated with a lower routine RII in the inpatient PAC settings. Depression is only important in the HHA model, as patients with depression have a higher routine RII than patients without depression in this setting.

Among the impairments, bowel incontinence is significant in all three components of the model shown in this table. In the HHAs, it doubles the probability that a patient will receive any routine services, while being associated with a 25-percent lower routine RII among those patients who received services. Bowel incontinence is associated with a 9-percent higher routine RII in the inpatient PAC model. Swallowing symptoms are significant only in the HHA intensity component where it is associated with a higher routine RII. No intake by mouth is significant in predicting the routine RII in both groups of settings, but has a negative impact on routine RII in the HHAs and a positive impact in the inpatient PAC settings.

The most severe problems with verbal expressions are associated with a higher routine RII in both the HHA and inpatient PAC settings. Frequent difficulty with expression is associated with a lower routine RII among HHA patients and is not significant in the inpatient PAC settings. Being able to sit with support is associated with a lower routine RII for both HHA and inpatient PAC patients, when compared to patients who can sit without support. Impaired respiratory status is only important in the HHAs, where it is associated with a higher probability of receiving any routine services.

Higher functional status, as measured by the Rasch motor function scale, is associated with a lower probability of receiving routine services in the HHAs. However, among patients who received any services, the relationship between functionality and the routine RII is positive for patients with a Rasch score below 35 and negative for patients with higher scores. The result is different for the inpatient PAC settings, where the relationship between functional performance and the routine RII is negative for all patients with a Rasch motor function core of greater than zero.

11.2.2.2 Setting-Specific and SNF/IRF Case-Mix Models of Total Inpatient Stay Routine/Nursing Intensity

Table 11-7 presents results from the setting-specific routine RII models for the three inpatient PAC settings along with the results from the combined SNF/IRF model. The setting-specific results for the HHAs can be found in the first two columns of **Table 11-6**). The **Setting-Specific Model** is a combination of components represented by the two HHA columns in **Table 11-6** and the LTCH, IRF and SNF columns in **Table 11-7**. The **HHA–LTCH–SNF/IRF Model** is a combination of components represented by the two HHA columns in **Table 11-6** and the LTCH intensity, and the SNF/IRF intensity columns in **Table 11-7**.

There is a relationship between age and the routine RII in the IRFs and the LTCHs, although the relationship differs between the settings. For instance, compared with patients aged 85 or older, patients had a higher routine RII in the IRFs for age categories less than age 75 and a lower routine RII in the LTCHs for patients ages less than 65. Age does not appear to be significantly related to the routine RII in the SNF model. In the combined SNF/IRF component, only the youngest group (age less than 65) is significant.

Having had an acute stay in the 2 months prior of the PAC admission is related to a higher routine RII in the SNF and LTCH components, but is not significant in the IRF component. Length of prior ICU stay is significant only in the LTCHs, where longer ICU stays are associated with a higher routine RII.

Several of the primary diagnosis variables are significant at the 5-percent level in the LTCHs, indicating that after controlling for other patient acuity measures, having a primary diagnosis other than stroke significantly impacts the routine RII. Several of the primary diagnoses are significant in the IRFs and/or SNFs, but they do not always enter into the components in the same way. For example, a primary diagnosis of orthopedic-head/spine is associated with a lower routine RII in the SNFs, but is not significant in the IRFs or the combined SNF/IRF settings. Another point of contrast is the fact that compared to stroke patients; patients in LTCHs with other primary diagnoses tend to have a higher routine RII while patients in the other two settings or the combined setting with other primary diagnoses tend to have a lower routine RII.

Several of the comorbidities are important in each of the settings, but their effects vary across settings. For instance, the renal comorbidity is associated with a higher routine RII in the IRF and LTCH components, while it is associated with a lower routine RII in the SNF component and is insignificant in the combined SNF/IRF component. Likewise, the stroke comorbidity is associated with a higher routine RII in the SNF model, but is not significant in the LTCH, IRF or the combined SNF/IRF components.

The comorbidity index is not significant in any of the settings after controlling for the comorbid indicators and the other patient acuity measures included in the models.

Among the major treatments, total parenteral nutrition is significant only in the LTCH component, where it is associated with greater routine intensity. This treatment at admission was rare in non-LTCH settings in our sample. Central line management is significant in the IRF, SNF, and SNF/IRF components, where it is associated with greater routine intensity. Hemodialysis is associated with a lower routine RII in the LTCH model and with a higher routine RII in the SNF model. Ventilator use is associated with greater routine intensity in the LTCHs and SNFs, but is not significant in the IRFs and is associated with only a limited number of observations in the SNF sample. The presence of pressure ulcers is significant only in the LTCH sample and is associated with greater routine intensity. The presence of a major wound is related to a higher routine RII in the SNFs and not significant in the other two model components or the SNF/IRF component.

Generally, the effect of cognitive status is very similar across the three settings and the combined SNF/IRF component, with cognitive impairment leading to lower routine intensity. Severely impaired status was significant across all components while moderately impaired status was additionally significant in the IRF and the SNF/IRF settings. Depression is not a significant factor in predicting the routine RII in any of the settings examined in this table.

Among the impairments, bladder incontinence is associated with a higher routine RII in the IRF and the SNF/IRF setting. Bowel incontinence is associated with a higher routine RII in the LTCH and with a lower routine RII in the SNF. Swallowing symptoms are related to a lower routine RII in the SNF model and no intake by mouth is associated with a higher routine RII in the IRF, LTCH, and SNF/IRF settings.

Problems with expression are generally not significant predictors in the SNF setting, but they tend to increase the routine RII in the IRFs and LTCHs. The effect of sitting endurance is generally similar in the IRFs and SNFs and the combined SNF/IRF component, where the inability to sit without support for 15 minutes is associated with a higher routine RII. In the LTCHs, the opposite appears to be true, as patients who can sit, but only with support get less intense routine care than patients who can sit without support. Impaired respiratory status is important in the IRF and the SNF/IRF components, where it is associated with a higher routine RII.

For the IRFs, SNFs, and the combined SNF/IRF settings the relationship between motor function, as measured by the Rasch motor function scale, and routine intensity is positive at lower levels of function, but becomes negative at higher levels of function. Thus, for most of the patients, higher functional level is associated with a lower intensity of routine care.

11.2.2.3 Diagnosis-Specific Case-Mix Model of Total Inpatient Stay Routine/Nursing Intensity

Table 11-8 presents the results for the diagnostic group routine RII components. In these components the impact of various patient acuity measures on the routine RII among patients in the inpatient PAC settings was allowed to vary by wide primary diagnosis categories. The **HHA–Inpatient PAC Diagnosis Group Model** is a combination of components represented by the two HHA columns in **Table 11-6** and the columns in **Table 11-8**.

Patient age is a significant factor in predicting the routine RII in each diagnosis-specific inpatient PAC model component, but it predicts the routine RII differently in each. For instance, compared to patients 85 years of age or over, patients aged 65 to 69 have a lower routine RII in the orthopedic component while such patients have a higher routine RII in the neurologic and respiratory components. Patients aged 75 to 84 have a lower routine RII in the medical/surgical component, and a higher routine RII in the respiratory component.

Having had an acute stay in the 2 months prior to the PAC admission is associated with a lower routine RII in the medical/surgical component while being associated with a higher routine RII in the respiratory component. Length of ICU stay is important in the medical/surgical, orthopedic, and respiratory components, with greater length of stay associated with a higher routine RII. In the orthopedic component, the result on the squared term for length of ICU stay indicates that the size of this positive effect on the routine RII diminishes for longer ICU stays.

The effects of different primary diagnoses are presented in the components for routine RII across the four different diagnostic groups. In **Table 11-8** the term “N/A” is used to indicate that a particular diagnosis is not applicable for modeling routine intensity within the diagnostic group, For example, patients with COPD are included only in the respiratory component. Thus the variable indicating COPD is not included in the other three models and is thus labeled as “N/A.” It should be noted that the ventilator/tracheostomy IPPS diagnosis has been rolled into the respiratory-surgical diagnosis in the component due to its strong correlation with the associated major treatment at PAC admission variable. In each component, there is a reference primary diagnosis used. This is noted as “Reference Group” in the table. The effects of the other relevant diagnoses should be interpreted relative to the routine intensity of the reference group.

The reference diagnosis for the neurologic component continues to be stroke. There is no significant difference in the routine RII for patients with the other neurological diagnoses when compared to the stroke patients. The reference group in the respiratory component is COPD. Neither of the primary diagnosis variables in this component is significant. The reference group in the orthopedic component is orthopedic-major medical, which includes such diagnoses as fractures to the hip and pelvis. In comparison to this group, patients with orthopedic minor medical and major surgical diagnoses have a lower routine RII. Finally, the comparison group for the medical/surgical component is other medical. In this case, patients with most of the other primary diagnoses have a higher routine RII than the patients with the “other medical” diagnosis.

The comorbidities were generally important in all four components, although which specific comorbidities were important and the direction of their effects on routine intensity varied. For example, the history of stroke comorbidity was only important in the orthopedic component and the orthopedic comorbidity was only significant in the neurologic group. The renal comorbidity was only important in the medical/surgical and respiratory components. The gastro-intestinal comorbidity was related to a higher routine RII in the respiratory component, but was related to lower routine intensity in the medical/surgical component. Generally, however, the significant effects were positive indicating that comorbidities increase the routine RII. In addition, a higher comorbidity index is associated with greater routine intensity in the neurologic model.

Among the major treatments, total parenteral nutrition was associated with greater routine intensity in the other medical/surgical, orthopedic, and respiratory components. Central line management was associated with a higher routine RII in the medical/surgical and orthopedic components. Hemodialysis was associated with a lower routine RII in the orthopedic component after controlling for the other variables. Ventilator treatment (weaning or non-weaning) was significant in the respiratory component.

The presence of severe pressure ulcers and major wounds were both related to a higher routine RII in the medical/surgical and orthopedic components, whereas only the presence of severe pressure ulcers was related to a higher routine RII in the respiratory component. Neither was significant in the neurologic component.

As far as cognitive status was concerned, severe impairment was associated with a lower routine RII, when compared to having no impairment, in all components except for the respiratory component. Moderate impairment was associated with a lower routine RII in the neurologic and orthopedic components. Depression was significant only in the orthopedic component, where it was associated with a higher routine RII.

Bladder incontinence was associated with greater routine intensity for orthopedic patients. Bowel incontinence was associated with a higher routine RII in both the medical/surgical and respiratory components. Swallowing symptoms were not significant in any of the components, although no intake by mouth was associated with a higher routine RII in the respiratory component.

Rarely being able to express oneself, when compared to having no difficulty, was associated with a higher routine RII, regardless of diagnostic group. Frequent difficulty was additionally associated with greater routine intensity in the neurologic and orthopedic components. The inability to sit for 15 minutes is associated with a higher RII in the neurologic and orthopedic components. After controlling for the other variables in the model, impaired respiratory status is important only in the neurologic component, where it is associated with greater routine intensity.

Increased functional ability, as measured by the Rasch motor function scale, is associated with a lower routine RII in the medical/surgical component at all levels of function. For the neurologic patients, increased function leads to a higher routine RII at low levels of function (where the Rasch score is less than 20) but to a lower routine RII at higher levels of function. For the orthopedic patients, increased function leads to greater routine intensity for patients with Rasch scores below 17 but leads to less routine intensity at higher level of function. Function is not significant in the respiratory component.

The coefficient on the interaction between the Rasch score and comorbidity index in the orthopedic component, suggests that at higher level of function the relationship between increased comorbidity and the routine RII is positive. For example, for patients with a Rasch motor function score of 50, an increase of the comorbidity index from 1 to 2 is associated with a 27-percent higher routine RII and increase of the comorbidity index from 2 to 3 is associated with a 24-percent increase in routine intensity.

11.3 Therapy RII Results

In this section, we discuss the multivariate regression results of predicting the episode/stay level therapy RII across the various PAC settings. The section begins with a summary of the results regarding model setting specificity. The section concludes with a more detailed description of the results of the models that were estimated.

11.3.1 Summary of Results on Therapy RII Model Setting Specificity

Table 11-9 presents the MSE-based R-squareds for the five model variations that were estimated. The global R-squared is in the first column. This is a measure of how much of the total variation in resource intensity across all PAC stays/episodes was explained by each of the five models described in Section 11.1. The next four columns provide measures of how much of the total variation in the therapy RII within each setting was explained by each model (see Section 11.2.1 for an explanation of the statistics presented and how they can be interpreted). The sixth column provides a measure of how much of the total variation in the therapy RII across all inpatient PAC stays was explained by each model. The seventh column provides a measure of how much of the total variation in the therapy RII across all SNF and IRF stays was explained by the SNF/IRF model. Finally, the last four columns provide measures of how much of the variation within the diagnostic groups was explained by the HHA–Inpatient Diagnostic Groups model.

Table 11-10 presents the predicted-to-actual ratios by setting for each of the five model variations that were estimated. A predicted-to-actual ratio of 1.0 indicates that a model can provide unbiased predictions of the therapy RII for a particular setting. Deviations from 1.0 indicate that the model either over predicts (if the ratio is greater than 1) or under predicts (if the ratio is less than 1) the therapy RII.

Table 11-11 presents how the global MSE-based R-squareds for each of the five models change when additional setting indicators are included. The first column gives the global R-squared for models that include only setting indicators. The second column reproduces the results from the first column of **Table 11-9**. The final column presents the R-squared for the models that included the additional setting indicators. For the All-PAC Settings model, indicators are included for three of the PAC Settings (SNF is the omitted or reference group). For the HHA–Inpatient PAC Settings model, indicators are included for two of the inpatient PAC settings (LTCH and IRF) in the inpatient PAC-only component (SNF is the omitted or reference group). For the HHA–LTCH–SNF/IRF model, an IRF setting indicator is added to the SNF/IRF-only component (SNF is the omitted or reference group). Finally, for the HHA–Inpatient Diagnostic Groups model, setting indicators for LTCH and IRF are included in the four inpatient PAC-only components (again, SNF is the omitted or reference group).

11.3.1.1 The All-PAC Settings Model

The All-PAC Settings model is the most restrictive in that it forces patient characteristics to have the same effect on the therapy RII regardless of setting or diagnosis. Thus, it is not surprising that the global R-squared for this model is the lowest among the five models being compared at 0.281 (see **Table 11-9**). This indicates that the model has the least power in explaining variation in the therapy RII across all settings. In past efforts to predict resource use, a common finding is that therapy intensity is more difficult to model than routine intensity using patient acuity measures. The model, which imposes consistency between all four settings in variable weighting and base rates, does a particularly poor job at explaining variation in therapy RII for HHA episodes, LTCH stays, and SNF stays; the MSE-based R-squared is negative for HHA episodes, 0.043 for LTCH stays, and 0.040 for SNF stays. In contrast, the IRF R-squared value was 0.158 in this model. This may imply that the strength of the All-PAC Settings model is derived through its prediction of the setting of care and less through accurate predictions of variation of the therapy RII within settings.

The All-PAC Settings model also provides biased predictions for the therapy RII across all settings (see **Table 11-10**). The bias is most pronounced for HHAs. Here the model, on average, predicts therapy resource use that is 37 percent greater than the mean value for this setting. This bias is not as pronounced as it was for the routine RII, however. The model also predicts a therapy RII in LTCHs that is 5 percent higher than the observed. At the same time, the model under predicts the therapy RII for IRFs and SNFs by 12 percent and 29 percent respectively.

The results presented in **Table 11-11** suggest that there are systematic differences between settings remaining after controlling for patient acuity in the All-PAC Settings model. The All-PAC Setting model estimated with only setting indicators features a global R-squared of 0.249. This type of model predicts resources based only on setting and has no controls for patient characteristics. In contrast, the R-squared for the All-PAC Settings model with patient acuity measures but without setting indicators is 0.281. Including both patient acuity and setting indicators in the All-PAC Setting model increases the R-squared to 0.362. This difference in the R-squareds is significant and indicates that setting indicators would still play an important role in predicting the therapy RII in the All-PAC Settings model, even after controlling for patient characteristics. Notably, as was the case for the routine RII models, in the All-PAC Setting model that includes setting indicators, the indicator for HHA setting is highly significant and less than 1.0. This finding suggests that payment adjustors for HHAs would need to be based on a significantly lower base rate than for other settings, even after case-mix adjustment.

11.3.1.2 HHA–Inpatient PAC Settings Model

Modeling HHA episodes separately from inpatient PAC stays improves the fit of the overall model significantly (see **Table 11-9**). The global R-squared increases from 0.281 to 0.356.[19] The R-squareds for three of the individual settings also improves. For example, it increases from a negative number to 0.179 for HHA episodes, from 0.158 to 0.186 for IRF stays and from 0.040 to 0.129 for SNF stays. The fit for all inpatient PAC stays also improves from

[19] This result is very similar to the one reported in the RTC, where the R-squared increased from 0.255 to 0.343.

0.106 to 0.155. However, this model fit the LTCH observations more poorly, with an R-squared of 0.028 as compared to 0.043 in the All-PAC Settings model.

The HHA–Inpatient PAC Settings model provides much less biased prediction of the therapy RII across all settings, except for LTCHs (see **Table 11-10**). Because HHA episodes are being modeled separately, the predictions for the therapy RII are unbiased for this setting. The bias for SNFs improves from 29 percent to roughly 9 percent, while the bias for IRFs improves from roughly 12 percent to less than 1 percent. Again, however, the model performs less well for LTCH observations, where the bias increases from 5 percent to nearly 12 percent.

These results are quite similar to the results that were reported in the Report to Congress Supplemental Report. The HHA–Inpatient PAC Settings model improves both the fit and bias in three of the four settings. The LTCH stays, however, are not modeled well using either the All-PAC Settings or the HHA–Inpatient PAC Settings model.

The inclusion of setting indicators in the HHA–Inpatient PAC Settings model increases the global R-squared value by 0.015 from 0.356 to 0.371 (see **Table 11-11**). Thus, the setting factors continue to explain a small amount of the variation not explained by the case-mix factors. This suggests that while separating HHAs from the inpatient PAC settings dramatically improved the explanatory power of the models, including additional sub-models within the PAC inpatient settings may be warranted.

11.3.1.3 HHA–LTCH–SNF/IRF Model

The next model removes the restriction that patient acuity measures have the same effects on the therapy RII in LTCHs as they do in the other two inpatient PAC settings as well as allowing for the base rate, or intercept, to be calculated separately for the LTCH and for the other two inpatient PAC settings. In this case, separate models are estimated for HHA episodes and LTCH stays, while SNF and IRF stays are combined in one model. Again, removing the restriction slightly improves the fit of the overall model, this time increasing the R-squared from 0.356 to 0.387 (see **Table 11-9**). The R-squared for IRF stays improves from 0.186 to 0.225, and it improves slightly from 0.129 to 0.132 for SNF stays. The R-squared improves dramatically for LTCH stays, increasing to 0.237. This should not be surprising, because LTCH stays are being modeled separately here. The fit for all inpatient PAC stays also improves, as the R-squared increases from 0.155 to 0.200.

The effect of the HHA–LTCH–SNF/IRF model on the predicted-to-actual ratio varies by setting (see **Table 11-10**). Because LTCH stays are being modeled separately, the predictions for the therapy RII are unbiased for this setting, and thus much improved. But the predicted-to-actual ratio actually is worse for the IRF stays than it was in the HHA–Inpatient PAC Setting model. Here the bias rises from a little less than 1 percent to 4.4 percent. At the same time, the bias inherent in the predictions for SNF stays falls from roughly 9 percent to 6.6 percent. Overall, none of the biases by setting exceed 10 percent.

The inclusion of setting indicators in this model increases the global R-squared by 0.004 from 0.387 to 0.391 (see **Table 11-11**). Thus, the additional setting factors explain very little of the variation in the therapy RII left unexplained by the case-mix factors, suggesting that separating the HHAs and LTCHs from the remaining two inpatient PAC settings dramatically improved the explanatory power of the models without the need for further setting indicators.

11.3.1.4 HHA–Inpatient Diagnostic Groups Model

This model is similar to the HHA–Inpatient PAC Settings model in that it models HHA episodes separately from inpatient PAC stays. In addition, for the patients admitted to IRFs, LTCHs, and SNFs, it allows the effects of patient characteristics on the therapy RII to vary across the following four broad diagnostic groups: neurological, orthopedic, respiratory, and not otherwise classified medical/surgical cases. The effects are not allowed to vary by inpatient PAC setting except insofar as any diagnostic group is predominant in any particular setting.

Overall, the model is an improvement over the HHA–Inpatient PAC Settings model. The R-squareds improve significantly in each inpatient PAC setting (see **Table 11-9**), and the global R-squared improves from 0.356 to 0.460. Also, the predictions carry less bias than those in the HHA–Inpatient PAC Settings model (see **Table 11-10**). The predicted-to-actual ratio improves from 1.008 to 1.007 for IRFs, from 1.118 to 1.091 for LTCHs, and from 0.908 to 0.928 for SNFs.

Whether the model is an improvement over the HHA–LTCH–SNF/IRF model is less clear. The global R-squared is better (0.460 as compared with 0.387), as are the R-squareds for IRFs and SNFs, but the R-squared is worse for the LTCH stays, falling from 0.237 to 0.130. Additionally, the predictions of therapy RII are biased for the LTCH stays in the HHA–Inpatient PAC Settings Diagnostic Groups model (the bias is 9 percent), while being unbiased in the HHA–LTCH–SNF/IRF model which models LTCH on its own.

The inclusion of setting indicators in the HHA–Inpatient Diagnostic Groups model increases the global R-squared by 0.017 from 0.460 to 0.477 (see **Table 11-11**). Thus, the setting factors continue to explain variation beyond what is explained by the case-mix factors. This suggests that while separating HHAs and modeling within diagnosis groups improves the explanatory power of the models, including additional setting information may be warranted.

11.3.1.5 Setting-Specific Model

The next model removes the restriction that patient acuity measures have the same effects on the therapy RII across the inpatient PAC settings. It allows the effects of patient characteristics on the therapy RII to be different in each PAC setting and also allows the base resource use (the intercept terms in the regressions) to vary across the four settings. By construction, this model provides unbiased predictions of the therapy RII in each setting (see **Table 11-10**). The Setting-Specific model has the best fit of all the models considered, with an R-squared of 0.463 (see **Table 11-9)**. It also improves the fit for IRFs and SNFs as compared with the HHA–Inpatient PAC and HHA–LTCH–SNF/IRF models. The improvement in the fit for SNF stays is substantial; the R-squared improves to 0.306 for this setting. The improvement in the fit for IRF stays is less pronounced but still significant; the R-squared rises to 0.302 When compared to the HHA-Diagnostic Groups model, the overall fit is roughly the same (the global R-squareds are 0.463 and 0.460). Also, the fit for IRFs is the same (the R-squareds are 0.301 and 0.302). The fit for SNFs is slightly better in the HHA–Inpatient Diagnostic Groups model, but the fit for LTCHs is much better in the Setting-Specific model (an R-squared of 0.237 as compared to 0.130).

11.3.1.6 Summary of Section 11.3.1

Both the HHA–LTCH–SNF/IRF and HHA–Inpatient Diagnostic Groups models represent improvements over the HHA–Inpatient PAC Settings model and may provide further evidence for the development of a framework for developing payment systems that minimize their setting-specific components. The HHA–Inpatient Diagnostic Groups model provides a similar overall fit to the Setting-Specific model but suffers from a comparatively poor fit for LTCH stays. The HHA–LTCH–SNF/IRF model provides relatively unbiased predictions, but also suffers from a relatively poorer fit for SNF and IRF stays. Given that majority large proportion of PAC episodes and stays are in SNFs, this poor performance for SNF stays may pose a problem.

Another main finding in this section is that the therapy RII models are less driven by medical case-mix factors than are the routine RII models. The lower relative explanatory power of the therapy models, compared to the routine models, may indicate that further work is necessary to understand variations in use of therapy resources and to improve these models. However, it may be the case that regulations and incentives in the existing payment systems limit the degree to which variation is explained by patient factors. Measures that reflect how much therapy was received have been used in prior models predicting therapy. However, incorporating utilization measures assumes the current practices are appropriate. In general, use measures are considered less desirable than patient acuity measures due to the "gameablity" of the measures through the ability to increase reimbursements by inappropriate increases in utilization. Measures of therapy use (e.g., minutes of therapy per day) are components of the current payment systems for HHAs, IRFs, and SNFs, either explicitly (HHAs and SNFs) or through certification requirements.

11.3.2 Detailed Regression Results

This section describes the pattern of significant coefficients in the models similar to the description for the routine RII in Section 11.2.2.

In all instances, the significance of a patient acuity factor is the significance holding all other factors in the model constant. This may mean that the presence of collinear variables in the model makes the coefficient associated with a particular variable not statistically significant. At the same time, it is important to note that the impact of these factors, significant or not, has been accounted for in the models and is represented in the model summary information.

In interpreting the coefficients, the models also differ in the degree to which the model spans multiple settings. If an acuity measure is strongly associated with treatment in a particular site of care, the coefficients in a multi-setting model may be influenced by the likelihood of seeing a patient in a particular setting, the overall practice patterns within a setting, and the degree to which the acuity measure impacts patient specific RII levels within the setting. In the single-setting models, some of the indicator variables included, especially for diagnoses, have very low frequencies. In such cases, care should be taken in interpreting the results.

11.3.2.1 Separate HHA and Inpatient Case-Mix Model of Total Inpatient Stay/HHA Episode Therapy Intensity

Table 11-12 presents the separate relative weights for the total HHA episode therapy RII (first and second columns) and the total PAC inpatient stay therapy RII (third column). As noted earlier, this model provides better predictions of the actual RII than the All-PAC Setting model, which combined both HHA and inpatient PAC settings. The coefficients presented in this table represent model components associated with the **HHA–Inpatient PAC Settings Model**. In addition, the two HHA columns shown in this table will also be applicable to all models that break out HHA, which include all models examined except for the **All-Settings Model**. Note that, in these analyses, the resource intensity from only the first HHA episode within a series of episodes for each patient is being modeled.

Younger patients generally have a smaller probability of receiving any therapy in their HHA episode compared to patients 85 years of age or over but age was not significant in predicting therapy intensity among HHA episodes that included therapy. Patients with a prior acute stay in the last 2 months prior to HHA admission are more likely to receive therapy, although, among those who do receive therapy the level of the therapy RII is slightly lower. These variables were not significant in the prediction of inpatient PAC therapy RII. In the inpatient PAC component, longer ICU stays are associated with a lower therapy RII, although this negative effect diminishes as the length of ICU stay increases and becomes positive at roughly 4 weeks.

Among the primary diagnosis categories, patients with most of the primary diagnoses included in the model had a lower therapy RII than patients in the omitted group or reference category, which consisted of patients who had stroke as their primary diagnosis. This was particularly pronounced for HHA patients, where most of the diagnoses were associated with both a decreased relative probability of receiving any therapy and a decreased amount of therapy among those patients who received at least some therapy.

The relationships between the comorbidities and the therapy RII are not consistent across the two types of settings modeled here. For instance, having a non-stroke-related neurologic comorbidity is associated with a significantly higher level of the therapy RII among HHA patients who receive therapy, while it is associated with a significantly lower level of the therapy RII for the patients in the inpatient PAC settings. Conversely, the head and spine-related comorbidity is associated with a significantly higher level of therapy RII in inpatient PAC settings, while having no significant impact on the therapy RII in HHAs. As a further example, orthopedic comorbidities are associated with a significantly higher probability of receiving therapy in the HHAs, while having no significant impact on the therapy RII in the inpatient PAC settings. The comorbidity index is related to the therapy RII only in the HHAs. For HHA patients, a higher comorbidity index (or more serious comorbid conditions) is related to a higher therapy RII even after controlling for the comorbid condition indicators.

Major treatments have an impact on the level of the therapy RII for both HHA and inpatient PAC patients, but their effects vary by setting. For instance, hemodialysis is associated with less intense therapy in the inpatient PAC settings, while ventilator and bowel catheter use are associated with less intense therapy in the HHAs. Caution should be taken in interpreting this finding in the HHA setting given the very low incidence of this treatment at admission in the

HHA population examined. Neither severe pressure ulcers nor major wounds are significantly related to the therapy RII in the inpatient PAC settings, while major wounds are associated with a lower probability of receiving any therapy in HHAs.

Cognitive ability has a stronger association with the therapy RII in HHAs than in the inpatient PAC settings. Severe cognitive impairment is associated with lower levels of the therapy RII for those HHA patients who receive at least some therapy. Cognitive ability is not significantly related to the therapy RII in the inpatient PAC settings.

As far as impairments are concerned, bowel incontinence is significantly related to a lower probability of receiving any therapy services for HHA patients, but is not significant in the inpatient PAC settings. Swallowing symptoms are associated with a higher therapy RII in HHAs but not in the inpatient PAC settings. Difficulties with expression are related to a higher therapy RII in the inpatient PAC settings but associated with a lower therapy RII in the HHAs. Sitting endurance is generally not significant in either of the model components. Finally, impaired respiratory status is associated with a lower therapy RII in the HHAs, while having no significant impact on the therapy RII in the inpatient PAC settings.

The fact that the squared term on the Rasch motor score is less than one indicates that increased functional status is associated with a lower therapy RII in the HHAs and that this relationship becomes more pronounced at higher levels of function. In the inpatient PAC settings it is related to a higher therapy RII at relatively low levels of functional ability. However, this relationship becomes negative at higher levels of functional ability. For instance, in the inpatient PAC settings, an increase in the Rasch motor score from 10 to 11 would increase the therapy RII by 1.3 percent, while an increase in the Rasch motor score from 20 to 21 would decrease the therapy RII by roughly 1 percent.

The result on the interaction term between the comorbidity index and the Rasch motor score for the HHA patients indicates that the effect of increased comorbidity on the therapy RII is less pronounced, and even becomes negative at higher functional levels. As an example, for an HHA patient with a Rasch motor score of 20, a one-unit increase in the comorbidity index would be related to a 2 percent increase in therapy RI, while for an HHA patient with a Rasch motor score of 30, a one-unit increase in the comorbidity index (poorer health) would be related to a 2 percent decrease in therapy RI.

11.3.2.2 Setting-Specific and SNF/IRF Case-Mix Models of Total Inpatient Stay Therapy Intensity

Table 11-13 presents the results for the Setting-Specific therapy RII models for the three inpatient PAC settings (the Setting-Specific results for HHAs can be found in the first two columns of **Table 11-12**). In the final column, the results for the combined SNF/IRF model are presented. The **Setting-Specific Model** is a combination of components represented by the two HHA columns in **Table 11-12** and the LTCH, IRF and SNF columns in **Table 11-13**. The **HHA–LTCH–SNF/IRF Model** is a combination of components represented by the two HHA columns in **Table 11-12** and the LTCH intensity, and the SNF/IRF intensity columns in **Table 11-13**.

There is a significant relationship between age and the therapy RII in each of the settings examined in this table, although the relationship appears different across the settings. For instance, the therapy RII for nonelderly patients is significantly higher than for patients 85 years of age or over in the IRFs and SNFs but not significantly higher among LTCH patients and is not a significant predictor in the combined SNF/IRF sample. Also, LTCH patients between the ages of 75 and 79 have a higher therapy RII, while SNF patients in the same age group have a lower therapy RII; IRF patients in this age group do not receive significantly more or less intense therapy. Having had a recent acute care stay prior to admission to the PAC setting has no effect on the therapy RII in LTCHs or IRFs, although it has a significant positive effect in SNFs. As there are by definition no community admits in SNF, this population is limited to the relatively few patients who have a qualifying intermediary PAC setting of sufficient duration. The length of ICU stays has an impact only for LTCH and IRF patients where increased ICU stays are associated with a lower therapy RII. This impact diminishes slightly with the length of the ICU stay for LTCH patients. Length of ICU stay was no longer a significant predictor when the IRF and SNF samples were combined.

Primary diagnosis is an important predictor of the therapy RII in all three inpatient PAC settings. Generally, coefficients on the primary diagnoses in all three models were less than 1.0, indicating that the diagnoses were associated with less intense therapy than the comparison group of patients with a primary diagnosis of stroke.

Several of the comorbidities are significant drivers of the therapy RII in SNFs, while fewer of the comorbidities are significant in the LTCH, IRF or the SNF/IRF settings. The comorbid conditions enter into the model components in different ways. For instance, a depression and psychiatric comorbidity is related to a lower therapy RII in IRFs, while it has no significant impact in LTCHs and SNFs. It should be noted that this coefficient is the impact of this comorbidity controlling for the response to the depression patient interview. The orthopedic comorbidity which includes orthopedic infection, rheumatoid arthritis, severe skeletal, musculoskeletal, and amputation (HCC39,40,41,42,43,44,45,189) is related to a higher therapy RII in SNFs and in the SNF/IRF sample, but has no significant impact in IRFs and LTCHs. Additionally, urinary tract infection and cardiovascular comorbidities are related to a higher therapy RII in IRFs and combined SNF/IRF, while they are related to a lower therapy RII in SNFs.

The comorbidity index is related to the therapy RII only in the SNFs. For SNF patients, a higher comorbidity index is related to a lower therapy RII.

Major treatments at admission are generally significant in predicting therapy RII. Total parenteral nutrition is related to a lower therapy RII in the IRF and SNF models and in the combined SNF/IRF sample, while central line management is related to a lower therapy RII in SNFs. Hemodialysis is related to a lower therapy RII in LTCHs, IRFs and SNF/IRFs. Severe pressure ulcers and major wounds are also insignificant in most settings, with the exception that the presence of a pressure ulcer is associated with a higher therapy RII in SNFs.

Severe cognitive impairments, controlling for other variables in the model, are associated with lower levels of the therapy RII in SNFs, while moderate cognitive impairment was positively significant compared to therapy RII for those in the reference group consisting of patients with intact or borderline cognitive status. Cognitive status was not a significant predictor in the other settings or in the SNF/IRF combined sample. Depression is not significant in any of the settings.

Among impairments at admission, bladder and bowel incontinence are not significantly related to the therapy RII in IRFs or in SNF/IRFs, while bladder incontinence is significantly associated with a higher therapy RII in SNFs and bowel incontinence is significantly associated with a higher therapy RII in LTCHs. The inability to take food or drink by mouth is associated with a higher therapy RII in all the LTCHs and SNFs, although the degree of the impact is greatest in SNFs.

Difficulty in expressing oneself is important in predicting therapy in SNFs, but not significant in the IRF and LTCH settings. The reference group is that group of patients with no difficulty in expressing themselves. Compared to this group, rarely being able to express oneself is related to a higher level of the therapy RII in the SNF model. Having some difficulty is associated with a lower therapy RII.

Generally, the inability to sit for 15 minutes without support is associated with a higher therapy RII in SNFs, IRFs and combined SNF/IRFs. Sitting endurance is not a significant driver of the therapy RII in LTCHs (although those patients whose sitting endurance could not be assessed due to medical restrictions had a lower therapy RII). Respiratory impairment is not significant in any of the models.

The impact of functional status in LTCHs, as measured by the Rasch motor function score, becomes increasingly associated with reduction in the therapy RII as functional status improves. For SNF and IRF patients, increased functional status is associated with a higher therapy RII at relatively low levels of functional ability. However, this relationship becomes negative at higher levels of functional ability.

11.3.2.3 Diagnosis-Specific Case-Mix Model of Total Inpatient Stay Therapy Intensity

Table 11-14 presents results for the diagnostic group therapy RII models. In these models, the impact of various patient characteristics on the therapy RII among patients in the inpatient PAC settings was allowed to vary by groupings of primary diagnosis categories. Doing this allowed for a much better overall fit of the model and better fits within each inpatient PAC setting when compared with the Combined Inpatient PAC Settings model. The **HHA–Inpatient PAC Diagnosis Group Model** is a combination of components represented by the two HHA columns in **Table 11-12** and the columns in **Table 11-14**. As a reminder, the diagnosis categories modeled separately include patients treated in inpatient PAC settings who have primary diagnoses that are neurological, orthopedic, respiratory, and medical/surgical conditions not otherwise categorized. Primary diagnosis was determined based on the MS-DRG in the initiating acute hospital.

Patient age is related to the level of the therapy RII for patients in each diagnostic group, but the effect of age differs across the groups. For example, among orthopedic patients, patients aged 65 to 69 receive less intense therapy than patients 85 years of age or over. The relationship is reversed among patients in the other diagnostic groups, where patients 65 to 69 years of age receive more intense therapy than patients 85 years of age or over. Also, orthopedic patients aged 75 to 79 had a lower therapy RII, while respiratory patients in the same age group had a higher therapy RII than patients 85 years of age or over.

Having had a recent acute stay prior to the PAC admission is significant in all but the neurologic component. In the medical/surgical component it is related to a lower therapy RII and in the orthopedic and respiratory components it is strongly related to a higher therapy RII. Length of ICU stay previous to PAC admission has a significant effect in the medical/surgical and respiratory components. The results on the squared term indicate that the marginal effect is generally negative for ICU stays of less than 1 month but that the effect becomes positive for cases where very long ICU stays were involved.

By construction, different primary diagnoses are present in the components for the therapy RII across the four diagnostic groups. In **Table 11-14,** the term "N/A" is used to indicate that a particular diagnosis is not applicable for modeling the therapy RII within the diagnostic group. For example, patients with COPD are only included in the component for respiratory patients. Thus, the variable indicating COPD is not included in the other three components and the coefficient is indicated as "N/A." In each component there is an omitted, or reference, diagnostic group used. This is noted as "reference group" in the tables. The significant diagnoses should be interpreted relative to the therapy intensity of the reference group.

The reference group for the neurologic model continues to be stroke. For the neurological group, patients with neurologic-medical diagnoses receive less intense therapy than those with a primary diagnosis of stroke. For the orthopedic group, the reference group was orthopedic-major medical patients which included such diagnoses as fractures of the hip and pelvis. In comparison to this group, minor and major orthopedic surgical diagnoses receive less intense therapy. For the respiratory group, patients with the reference primary diagnosis, COPD, were significantly associated with less intense therapy than those with the other two respiratory diagnoses used to define the group. It should be noted that the ventilator/tracheostomy diagnosis has been rolled into the respiratory-surgical diagnosis due to its strong correlation with the associated major treatment at PAC admission variable. Finally, four of the medical/surgical diagnoses are significant predictors of therapy intensity compared to the reference diagnosis, other medical. The four include vascular-surgical, the endocrine medical and surgical diagnoses, and the hematology surgical diagnosis. Patients with the first three diagnoses got more intense therapy than those in the comparison group, while patients with the hematology surgical diagnosis got less intense therapy.

The comorbidities play a significant role in predicting therapy RII in each diagnostic group, although they vary in their effect across the groups. For example, the cardiovascular comorbidity is related to a higher therapy RII among neurologic and respiratory patients and lower therapy RII among patients in the other two groups. The urinary tract infection comorbidity is related to a higher therapy RII among neurologic patients and is not significant in the other components. The comorbidity of stroke is significantly related to a higher therapy RII in three of the diagnosis groups. This impact was particularly strong in the orthopedic group where the presence of this comorbidity was associated with a 2-fold increase in therapy intensity. Stroke comorbidity was not significant in the neurologic component where, presumably, the therapy intensity was dominated by neurologic conditions captured in the primary diagnosis rather than the comorbidities.

The comorbidity index is significant in the medical/surgical, orthopedic, and respiratory models with a higher index being associated with less intensity. At the same time, the relationship between the index and the therapy RII varies across the models and the relationship changes at different points in the index. For the average medical/surgical patient (the index is equal to 2.3, on average, for these patients), a 1-unit increase in the index would be related to a 7 percent decrease in the therapy RII. For the average orthopedic patient (the index is equal to 1.5, on average, for these patients), a 1-unit increase in the index would be related to a 9 percent increase in the therapy RII.

Among the major treatments examined, total parenteral nutrition is related to a lower therapy RII in the neurologic, orthopedic, and respiratory components. Central line management is related to a lower therapy RII among orthopedic and medical/surgical patients and hemodialysis is related to a lower therapy RII in the medical/surgical, neurologic, and orthopedic components. Ventilator use is associated with a lower therapy RII in the neurologic and orthopedic components, while bowel catheter use is associated with a higher therapy RII in the medical/surgical component and a lower therapy RII in the orthopedic component. The presence of a major wound or pressure ulcer is generally not related to the level of the therapy RII, except in the case of orthopedic patients where the presence of a major wound is related to a more intense therapy.

Cognitive ability, compared to the reference group of no cognitive impairment, is significantly related to the therapy RII only in the orthopedic component. In this component, severe cognitive impairment is related to a lower therapy RII. Depression is not statistically significant in any of the diagnostic group components after controlling for the other variables in the model including the depression/psychiatric disorder comorbidity indicator.

Bowel and bladder incontinence are significantly related to the therapy RII in only the respiratory component, where each type of incontinence is associated with a higher therapy RII. Swallowing symptoms are only significant in the orthopedic component, where they are associated with lower levels of the therapy RII. No intake by mouth is significant in the medical/surgical and respiratory components, where it is associated with a higher level of the therapy RII.

Difficulty with expression is significantly associated with the therapy RII for patients in all four groups. Frequent or extreme difficulty is associated with a higher therapy RII for patients in the medical/surgical, neurologic and orthopedic diagnostic groups, although the effect is much greater for the orthopedic patients. It should be noted that these significance levels show the impact of these variables holding all other patient acuity measures, including cognitive impairment, constant.

Lack of sitting endurance or the inability to assess sitting endurance due to medical restrictions is significantly related to a higher therapy RII in the neurologic and orthopedic components, while it is related to a lower therapy RII in the respiratory component. Impaired respiratory status is significant in the medical/surgical group, where it is associated with higher levels of the therapy RII.

Functional ability as measured by the Rasch motor scale is significant in all of the models. In each model, the marginal effect of increased functional ability as measured by the Rasch motor function score is positive at lower levels of functional ability (where the Rasch score is less than 30), but negative at higher levels of ability (roughly where the Rasch score is greater than 30.)

For respiratory patients, the level of functional ability also plays a role in determining the effect of an increase in the comorbidity index in that the effect of increasing the index diminishes at higher levels of function. For the average respiratory patient (the index is equal to 3.4) with a motor function score of 30, a 1-unit increase in the index would be related to a 0.2-percent decrease in the therapy RII. For the same patient with a motor function score of 50, a 1-unit increase in the index would be related to a 6-percent decrease in the therapy RII.

11.4 The Effect of Weighting the Analyses

11.4.1 Post-stratification Weighting

In collecting the data used in these analyses, both LTCH and IRF stays were oversampled. This was done because each setting accounts for a small percentage of PAC stays nationally (about 2 percent for LTCHs and about 2.5 percent for IRFs). Given the overall sample size, pure random sampling would have produced too small a number of LTCH and IRF cases to analyze with any precision. Thus, in the analysis sample, LTCH stays account for 12 percent and IRF stays account for 18 percent of the observations. HHAs were not oversampled in the sense of the number of participating providers. However, HHA cases were disproportionately available for the RII analysis because HHA cost and resource use information could be derived from claims and was not reliant on primary data collection occurring within a sampled time window. Consequently, SNF stays, which account for one-third of all PAC episodes/stays nationally, account for less than 14 percent of the observations in the sample. This characteristic of the data used in this analysis leads to the question of whether the findings are robust to alternative models of weighting the relative number of patients in the PAC settings.

In the analyses that follow, we weight each observation so that the weighted number of stays/episodes in each setting is proportional to the distribution of stays nationally. This means that observations on SNF stays are given a heavy weight when compared with the weight for LTCH stays; the ratio of the weights is roughly 15 to 1. They are also given a very heavy weight when compared with the weight for IRF stays; the ratio is of these weights is roughly 17 to 1. When the sample is reweighted to represent a closer approximation to the use of PAC settings nationally it is expected that the estimated coefficients in cross-setting models will be closer to what they would be in SNFs.

11.4.2 The Effect of Weighting on Goodness of Fit

Table 11-15 provides the MSE-based R-squareds for the weighted routine RII models. The results in this table can be compared with the results in **Table 11-3**. One trend that becomes apparent is that the overall fits of the weighted models are worse than the overall fits of the unweighted models presented in **Table 11-3**. Considering the fit of the models for the individual settings, the weighted models fit the IRF and LTCH observations more poorly than the unweighted models. The fit for the IRF observations is particularly poor when using the weights resulting in R-squareds being negative for this setting in both the HHA–LTCH–SNF/IRF and HHA–Inpatient Diagnostic Groups models and being much lower in the All-PAC Settings and HHA–Inpatient PAC Settings models. The weighted models fit the SNF observations much better than the unweighted models as reflected by the improved R-squareds in the SNF column in **Table 11-15**. This is not surprising given the fact that the weighted models are weighted toward the SNF observations. The fits for the other settings are poorer, while the fits for the SNF observations are better.

Table 11-16 provides the MSE-based R-squareds for the weighted therapy RII models. The results in this table can be compared with the results in **Table 11-9**. The same patterns emerge here as well. The weighted models fit the SNF observations much better as reflected in the higher R-squareds in the SNF column. The LTCH and IRF observations are much more poorly fit. In the models where the weights are relevant the R-squareds for the IRF and LTCH observations are all negative, which reflects a very poor fit in each case. The overall fit of the HHA–Inpatient PAC Settings model is improved with weighting (the overall R-squared goes from 0.356 to 0.396), which is the result of two factors: (1) the much improved fit for the SNF observations in the weighted model and (2) the heavy weight applied to the SNF observations in generating the overall R-squared. A similar result regarding the overall fit is found for the HHA–Inpatient PAC Settings and the HHA–Inpatient Diagnostic Groups models.

11.4.3 The Effect of Weighting on Predicted-to-Actual Ratios

Table 11-17 presents the predicted-to-actual ratios by setting for the weighted routine RII models. The results in this table can be compared with the results in **Table 11-4**. While weighting the analyses results in lower R-squareds for the IRF observations, it does provide less biased predictions for routine RII in IRFs in most cases. For example, the bias for IRFs in the unweighted HHA–Inpatient PAC Settings model is 9.4 percent, while the bias for IRFs in the weighted version is 5.9 percent. At the same time, the weighting provides for more biased predictions for LTCHs. For example, the bias for LTCHs in the unweighted HHA–Inpatient PAC Settings model is 7.9 percent, while the bias for LTCHs in the weighted version is 13 percent. Not surprisingly, weighting the analyses provides for less biased predictions of routine RII for the SNF observations.

Table 11-18 presents the predicted-to-actual ratios by setting for the weighted therapy RII models. The results in this table can be compared with the results in **Table 11-10**. In three of the four models where weighting is relevant, the bias inherent in the predictions for the IRF observations is improved by using the weights, despite the fact that the fit for the IRF observations is poor. At the same time, weighting provides for more biased predictions of therapy RII for LTCHs. In addition, the weighting changes the direction of the bias. In the unweighted models, therapy RII is generally over predicted. In the weighted models, therapy RII is generally under predicted. Not surprisingly, weighting the analyses provides for less biased predictions of therapy RII for the SNF observations.

In summary, although there were changes, the conclusions related to the relative strengths of the models remained consistent in the weighted and the unweighted analyses.

11.5 Summary of Key Findings and Conclusions

In evaluating the strengths and weaknesses of each of the modeling approaches, it should be emphasized that the data modeled are from the real world and reflect the way care is delivered under current rules and payment systems. Therefore, models that fit the data best are not necessarily fitting ideal patterns of care within and across settings. Some examples include the following. Practice patterns are influenced by rules in IRFs concerning expected therapy regimens for all admitted patients. The IRFs and LTCHs have financial incentives to avoid short stays. Inpatient hospitals typically have higher nursing levels for all patients than SNFs. These features that drive resource use, in addition to the patient characteristics, can be captured in an indirect way through the use of setting indicators. The models presented in this chapter force the effects of patient characteristics to be the same for each setting in regressions that span settings such as the All-PAC setting, the Inpatient-PAC setting, and the SNF/IRF components of their respective models. Models that capture all the idiosyncrasies of each setting are the Setting-Specific models that allow the effect of all patient characteristics on resource use to be customized to the current practices in each setting.

We have presented models for routine services and therapy services that are agnostic to setting (the All-PAC Settings model), partly agnostic (the HHA–Inpatient PAC Settings, HHA–LTCH–SNF/IRF, and HHA–Inpatient Diagnostics Groups models), and models that are setting-specific. The models combining inpatient PAC settings and home health services are statistically worse than all other models. We consider that there is strong evidence that home health care, an outpatient service, should be modeled separately as a setting to improve both the model for home health care and the inpatient PAC settings. The discussion will be concentrated on the choices among the inpatient PAC models.

We have concentrated on setting prediction as a prime evaluative criterion in the analysis. This is not the only criterion that could be used. The models that stratify clinically indicate another criterion that could be used. It is important to predict well for all types of patients, yet our analysis has concentrated on setting even when modeling by clinical strata. This is driven by the consideration that Medicare pays specific provider types for the delivery of care. Each provider type has a range of patient types and the provider's concern is an accurate prediction for patients within the context of its setting, not in the abstract. It is within this environment that we consider the setting results as important. We have developed models intended to distinguish patients clinically rather than by setting but have used the performance within settings as an evaluation criterion. The fits reported are, however, fits to current practice patterns.

The discussion below focuses mostly on the models that were not population weighted. We have shown that the heavy weight of the SNF patients in the weighted inpatient PAC setting models has deleterious effects on predictions for the other settings. What this does show, however, is that setting weighting can be used as a tool to balance the explanatory power of combined models so acceptable predictive power occurs in each setting rather than optimal power in one setting and poor power in another.

The following models are discussed:

1. The combined inpatient PAC model
2. The LTCH alone + IRF/SNF combined model
3. The combined inpatient PAC stratified clinically by diagnosis group model
4. The setting-specific model

11.5.1 Routine Resource Intensity

Explanatory power, as measured by the mean squared error R-squared computation, has to be interpreted carefully. Frequently the R-squared is higher for a model predicting across settings than it is for any setting included in that model. Looking at the inpatient PAC combined model (Model 1), the overall R-squared is an excellent 0.648. When isolating the patients in each setting and computing explanatory power for those patients, the R-squared is much lower in the SNF, moderate in IRFs, and comparably high only in the LTCH (see **Table 11-3**). The model has distinguished patients well but much of the power is distinguishing the types of patients in each setting and their nursing resource use related to setting. Within each setting, some patterns of care variations are harder to explain with the clinical variables constrained to be equal. The other models improve on this.

Staying in the range of non-site-specific models, the version stratified by a patient's main medical condition (Model 3) does better. Such a model can do better because each diagnostic group has independently determined coefficients for the explanatory variables. Refinement of such models with potential reweighting of the data could make this an appealing model in the class of models with no setting discrimination.

The other two models, Model 2 with LTCH modeled on its own and IRF and SNF together, and Model 4, with all settings separate, are variations on separate models for each setting. In Model 2, the LTCH explanatory power is not quite as good as it is in the condition-stratified model, although the SNF and IRF do better. The models that are separate for each setting are better than the other models except for the case of LTCH, for which the condition-stratified model does very well for LTCH patients and provides better explanatory power for respiratory patients.

Overall, selecting a model to pursue depends on the level of importance given to setting-specific criteria. If this is the main criterion, limited by the aforementioned idiosyncrasies of current payment systems being in the data, then the Setting-Specific models can be further optimized. Weighting by setting is irrelevant in such a model structure. Because the ancillary services covered by the provider types are also specific to the providers, it is easy to incorporate these into the model.

Looking toward a future in which not only a common set of assessment data is used for the models, but a more patient-based than provider-based payment system is used, a common inpatient PAC settings model with stratification by diagnosis group is promising for future development. The model estimated here is a first draft model using no reweighting of the sample. The experiment in population weighting of the data shows that by weighting the LTCH less and the SNF and IRF more, models could be created that even out the explanatory power. In this model the LTCH explanatory power was much higher than that in the IRF or SNF because we are disproportionately fitting current patterns of care in LTCHs. The diagnosis-stratified model predicts as well for each of the diagnosis groups as the Setting-Specific models predict for the individual settings.

11.5.2 Therapy Resource Intensity

Models for the prediction of therapy resources have somewhat poorer explanatory power than those for routine services. The current payment systems get much of their explanatory power by building in degrees of predicted therapy or actual visits into the models. Our models have used clinical factors only and have been relatively successful in doing so (see **Table 11-9**).

The pattern observed in model explanatory power is similar to that in the routine resource models. The models that generally have the best power for settings are the stratified clinical model and the Setting-Specific model. Only the R-squared for LTCHs is lower in the clinically stratified model. Therapy is generally more limited in the LTCH patients because most of them are relatively severely ill with multiple comorbidities.

As with the routine care models, the degree of importance given to optimizing explanatory power for settings is a consideration in the relative attractiveness between alternative approaches. As with routine services, it may not be desirable to overfit the RII as driven by the current practice patterns and systems. In the case of therapy, the advantage of the Setting-Specific model is only in the LTCH; a setting-agnostic model is essentially equal to the Setting-Specific model.

11.5.3 Overall

The modeling done in this work has shown that a uniform set of data sources, claims, and the CARE assessment instrument can be used across all the settings. It has also been demonstrated that it is reasonable to create models covering multiple settings. We find that segregating the HHA setting, which is outpatient, provides better results for both the HHA and the inpatient PAC settings that remain.

Our evaluation of the models is contingent on the underlying data that reflect the practices driven by current conditions of participation of the provider types and payment systems. The implication is that choosing the models with the best explanatory power is allowing the past to drive the future. In a system in which similar types of patients may be served by different types of providers or multiple types of providers, it would be preferred to create payment systems with a degree of commonality. Settings do differ by the range of services they are expected to provide under current law. SNFs do not cover the same range of ancillary services as hospitals, for example. Differences in facility overhead and required staffing are also present. A final payment model would have to recognize the differences that remain in the systems.

We expect the models pursued to be able to be updated without major restructuring. For example, possible changes in the rules for LTCH patients in the mean length-of-stay requirement or for IRFs in therapy requirements could change the mix of patients. Models such as these that are strongly based on patient characteristics may need relatively little adjustment to the extent the models cover patients across settings. Setting-Specific models might need more adjustment.

If any of these approaches are used, the nature of the development would be to (1) refine the clinical covariates in the models and (2) if a medical condition stratification is used, refine the definitions and extend the modeling to ancillary services and methods to combine the separate components of the prediction models.

Table 11-1
Summary descriptive statistics on per inpatient PAC stay total routine resource intensity index by diagnosis group

Setting	Number of stays/ episodes in sample	Mean LOS	Mean routine RII	Std. dev.	5th %tile	25th %tile	50th %tile	75th %tile	95th %tile
Neurologic	401	23.5	72.3	52.5	14.5	37.5	60.9	91.3	168.5
Orthopedic	756	22.4	51.8	40.0	11.1	26.1	41.9	64.4	130.6
Respiratory	473	33.9	156.9	165.9	17.4	53.2	99.1	203.0	477.6
Other Med/Surg	1,004	26.8	80.3	82.2	15.0	33.5	57.5	95.5	223.7

NOTE: Resource intensity index measured as RN-equivalent hours. Diagnosis is determined based on the MS-DRG reported on the claim for the acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the PAC claim was grouped into an MS-DRG. Med/Surg = medical-surgical diagnosis, not otherwise categorized; PAC = post-acute care; RII = resource intensity index.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-2
Summary descriptive statistics on per inpatient PAC total stay therapy resource intensity index by diagnosis group

Setting	Number of stays/ episodes in sample	Mean LOS	Mean therapy RII	Std. dev.	5th %tile	25th %tile	50th %tile	75th %tile	95th %tile
Neurologic	401	23.5	61.3	53.7	3.3	24.4	46.9	85.4	163.6
Orthopedic	756	22.4	39.3	45.7	0.6	13.6	28.9	52.6	106.1
Respiratory	473	33.9	39.8	37.4	1.2	14.0	30.6	54.7	113.5
Other Med/Surg	1,004	26.8	38.7	37.3	1.2	14.0	30.3	52.6	104.1

NOTE: Resource intensity index measured as licensed therapist-equivalent hours. Diagnosis is determined based on the MS-DRG reported on the claim for the acute hospitalization. If no claim for a prior acute hospitalization was found, the primary diagnosis on the PAC claim was grouped into an MS-DRG. Med/Surg = medical-surgical diagnoses, not otherwise categorized; PAC = post-acute care; RII = resource intensity index.

SOURCE: RTI International analyses of CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-3
MSE-based R-squareds for the inpatient PAC stay/HHA episode routine resource intensity index models

Model	Global	HHA	IRF	LTCH	SNF	Inpatient	SNF/ IRF	Neuro Diagnostic Groups	Ortho Diagnostic Groups	Resp Diagnostic Groups	Med/Surg Diagnostic Groups
All-PAC Settings[1]	0.683	−5.021	0.185	0.565	0.033	0.606	—	—	—	—	—
HHA–Inpatient PAC Settings[2]	0.745	0.141	0.249	0.619	0.093	0.648	—	—	—	—	—
HHA–LTCH–SNF/IRF[3]	0.769	0.141	0.381	0.645	0.223	0.682	0.320	—	—	—	—
HHA–Inpatient Diagnostic Groups[4]	0.788	0.141	0.316	0.699	0.180	0.709	—	0.350	0.415	0.714	0.662
Setting-Specific[5]	0.778	0.141	0.424	0.645	0.377	0.695	—	—	—	—	—

[1] The All-PAC Settings models are composed of two components: (1) a component predicting whether routine services are used and (2) a component predicting the amount of services used if positive.

[2] The HHA–Inpatient PAC Settings models are composed of three components: (1) an HHA-only component predicting whether routine services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) an inpatient PAC-only component predicting the amount of services used.

[3] The HHA–LTCH–SNF/IRF models are composed of four components: (1) an HHA-only component predicting whether routine services are used; (2) an HHA-only component predicting the amount of services used if positive; (3) an LTCH-only component predicting the amount of services used; and (4) a combined SNF and IRF component predicting the amount of services used.

[4] The HHA–Inpatient Diagnostic Groups models are composed of six components: (1) an HHA-only component predicting whether routine services are used; (2) an HHA-only component predicting the amount of services used if positive; (3-6) separate inpatient PAC-only components predicting the amount of services used for neurologic patients, orthopedic patients, respiratory patients, and patients with other medical/surgical primary diagnoses.

[5] The Setting-Specific models are composed of five components: (1) an HHA-only component predicting whether routine services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) separate IRF-, LTCH-, and SNF-specific components predicting the amount of services used.

NOTE: All models include 6,705 patients in the analytic sample. All model variations examined in this table do not include setting indicators within the model components. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; Med/Surg = Medical/surgical, not otherwise categorized; MSE = mean-squared error; Neuro – neurological; Ortho = orthopedic; PAC = post-acute care; Resp = Respiratory; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-4
Ratio of predicted to actual routine resource intensity index for the inpatient PAC stay/HHA episode routine resource intensity index models, by setting

Model	HHA	IRF	LTCH	SNF
All-PAC Settings[1]	2.996	0.829	0.826	0.731
HHA–Inpatient PAC Settings[2]	1.000	1.094	0.921	1.077
HHA–LTCH–SNF/IRF[3]	1.000	1.016	1.000	0.975
HHA–Inpatient Diagnostic Groups[4]	1.000	1.077	0.941	1.047
Setting-Specific[5]	1.000	1.000	1.000	1.000

[1] The All-PAC Settings models are composed of two components: (1) a component predicting whether routine services are used and (2) a component predicting the amount of services used if positive.

[2] The HHA–Inpatient PAC Settings models are composed of three components: (1) an HHA-only component predicting whether routine services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) an inpatient PAC-only component predicting the amount of services used.

[3] The HHA–LTCH–SNF/IRF models are composed of four components: (1) an HHA-only component predicting whether routine services are used, (2) an HHA-only component predicting the amount of services used if positive, (3) an LTCH-only component predicting the amount of services used, and (4) a combined SNF and IRF component predicting the amount of services used.

[4] The HHA–Inpatient Diagnostic Groups models are composed of six components: (1) an HHA-only component predicting whether routine services are used; (2) an HHA-only component predicting the amount of services used if positive; (3-6) separate inpatient PAC-only components predicting the amount of services used for neurologic patients, orthopedic patients, respiratory patients, and patients with other medical/surgical primary diagnoses.

[5] The Setting-Specific models are composed of five components: (1) an HHA-only component predicting whether routine services are used,; (2) an HHA-only component predicting the amount of services used if positive, and (3) separate IRF-, LTCH-, and SNF-specific components predicting the amount of services used.

NOTE: All models include 6,705 patients in the analytic sample. All model variations examined in this table do not include setting indicators within the model components. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MSE = mean-squared error; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-5
MSE-based R-squareds for the inpatient PAC stay/HHA episode routine resource intensity index models, with and without setting indicators

Model	Setting indicators only	Patient acuity measures only	Setting & patient acuity measures
All-PAC Settings[1]	0.448	0.683	0.753
HHA–Inpatient PAC Settings[2]	0.448	0.745	0.754
HHA–LTCH–SNF/IRF[3]	0.448	0.769	0.769
HHA–Inpatient Diagnostic Groups[4]	0.448	0.788	0.795
Setting-Specific[5]	N.A.	N.A.	0.778

[1] The All-PAC Settings models are composed of two components: (1) a component predicting whether routine services are used and (2) a component predicting the amount of services used if positive.

[2] The HHA–Inpatient PAC Settings models are composed of three components: (1) an HHA-only component predicting whether routine services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) an inpatient PAC-only component predicting the amount of services used.

[3] The HHA–LTCH–SNF/IRF models are composed of four components: (1) an HHA-only component predicting whether routine services are used; (2) an HHA-only component predicting the amount of services used if positive; (3) an LTCH-only component predicting the amount of services used; and (4) a combined SNF and IRF component predicting the amount of services used.

[4] The HHA–Inpatient Diagnostic Groups models are composed of six components: (1) an HHA-only component predicting whether routine services are used; (2) an HHA-only component predicting the amount of services used if positive; (3-6) separate inpatient PAC-only components predicting the amount of services used for neurologic patients, orthopedic patients, respiratory patients, and patients with other medical/surgical primary diagnoses.

[5] The Setting-Specific models are composed of five components: (1) an HHA-only component predicting whether routine services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) separate IRF-, LTCH-, and SNF-specific components predicting the amount of services used.

NOTE: All models include 6,705 patients in the analytic sample. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MSE = mean-squared error; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-6
Separate HHA and inpatient PAC case-mix model of the total inpatient PAC stay/HHA episode routine/nursing resource intensity index

Variable	HHA Routine Stage 1 Pr(>0)	HHA Routine Stage 2 Intensity	Inpatient Routine Intensity
64 years and under	N.S.	N.S.	N.S.
65-69 years	N.S.	N.S.	N.S.
70-74 years	N.S.	1.364‡	N.S.
75-79 years	N.S.	N.S.	N.S.
80-84 years	0.820§	N.S.	N.S.
85 years and above (reference group)	—	—	—
Acute Stay Past 2 Months	1.580‡	0.869§	N.S.
Number of Days in ICU	N.S.	N.S.	1.016‡
Number of Days in ICU - Squared	N.S.	N.S.	0.999§
Prim DX: Stroke (reference group)	—	—	—
Prim DX: Neurologic Surgical	N.S.	N.S.	N.S.
Prim DX: Neurologic Medical	0.356‡	N.S.	N.S.
Prim DX: Respiratory Surgical	N.S.	1.907‡	N.S.
Prim DX: Respiratory Medical	N.S.	1.418‡	N.S.
Prim DX: COPD	N.S.	1.660‡	N.S.
Prim DX: Vascular-Surgical	N.S.	1.683‡	N.S.
Prim DX: Cardio-Surgical	N.S.	N.S.	N.S.
Prim DX: Cardio-Vascular General	N.S.	1.305‡	N.S.
Prim DX: Vascular-Medical	N.S.	N.S.	0.538‡
Prim DX: Cardio-Medical	N.S.	1.482‡	N.S.
Prim DX: Orthopedic Minor Surgical	0.370§	N.S.	N.S.
Prim DX: Orthopedic Major Surgical	N.S.	N.S.	0.683‡
Prim DX: Orthopedic - Head/Spine	0.277‡	N.S.	N.S.
Prim DX: Orthopedic Minor Medical	0.301‡	N.S.	0.778§
Prim DX: Orthopedic Major Medical	N.S.	N.S.	N.S.
Prim DX: Integumentary Surgical	N.S.	N.S.	1.337§
Prim DX: Integumentary Medical	N.S.	1.647‡	N.S.
Prim DX: Endocrine Surgical	N.S.	2.154‡	N.S.
Prim DX: Endocrine Medical	N.S.	1.599‡	N.S.
Prim DX: Kidney Surgical	N.S.	1.867‡	N.S.
Prim DX: Kidney Medical	N.S.	N.S.	N.S.
Prim DX: Infectious Disease Surgical	N.S.	0.212§	N.S.
Prim DX: Infectious Disease Medical	N.S.	N.S.	N.S.
Prim DX: Septicemia	0.169‡	N.S.	N.S.
Prim DX: Transplant	N.S.	N.S.	1.674‡
Prim DX: GI Minor Surgical	N.S.	1.483‡	0.629‡
Prim DX: GI Major Surgical	N.S.	N.S.	N.S.

(continued)

Table 11-6 (continued)
Separate HHA and inpatient PAC case-mix model of the total inpatient PAC stay/HHA episode routine/nursing resource intensity index

Variable	HHA Routine Stage 1 Pr(>0)	HHA Routine Stage 2 Intensity	Inpatient Routine Intensity
Prim DX: GI Minor Medical	N.S.	N.S.	N.S.
Prim DX: GI Major Medical	0.241‡	1.361‡	0.771§
Prim DX: Hematology Surgical	N.S.	1.887‡	N.S.
Prim DX: Hematology Medical	N.S.	N.S.	N.S.
Prim DX: Other Surgical	N.S.	1.364‡	0.830‡
Prim DX: Other Medical	0.115‡	1.733‡	0.809§
Comorb DX: Morbid Obesity	N.S.	1.296§	N.S.
Comorb DX: Endocrine and Metabolic	N.S.	N.S.	N.S.
Comorb DX: GI and Liver	2.219‡	N.S.	1.098‡
Comorb DX: Orthopedic	0.722‡	N.S.	N.S.
Comorb DX: Depression and Psych	N.S.	0.776‡	1.076§
Comorb DX: Head/Spine	N.S.	1.704‡	1.272‡
Comorb DX: Neurologic (not stroke)	N.S.	0.823‡	N.S.
Comorb DX: Cardio-Vascular	N.S.	N.S.	1.105‡
Comorb DX: Stroke	N.S.	0.738‡	N.S.
Comorb DX: Respiratory	N.S.	0.827‡	N.S.
Comorb DX: Renal	N.S.	0.337‡	1.107§
Comorb DX: Cellulitis	N.S.	N.S.	1.185‡
Comorb DX: UTI	3.056‡	0.728§	1.160‡
Total Parenteral Nutrition	0.126‡	N.S.	1.223‡
Central Line Management	N.S.	N.S.	1.145‡
Hemodialysis	N.S.	4.477‡	0.845‡
Ventilator (weaning or non-weaning)	N.S.	N.S.	1.364‡
Indwelling Bowel Catheter	0.103‡	N.S.	N.S.
Severe Pressure Ulcer	10.701‡	N.S.	1.341‡
Major Wound	7.949‡	1.641‡	1.095‡
Cognitive Status Severely Impaired1	N.S.	N.S.	0.872‡
Cognitive Status Moderately Impaired	N.S.	N.S.	0.922‡
Cognitive Status Intact or Borderline (reference group)	—	—	—
Cognitive Status Missing	0.279‡	N.S.	N.S.
Depressed Often or Always	N.S.	1.117§	N.S.
Depressed Missing	N.S.	N.S.	N.S.
Bladder Incontinence	N.S.	N.S.	N.S.
Bowel Incontinence	2.042‡	0.735‡	1.088‡
Swallowing Symptoms	N.S.	1.685‡	N.S.
No Intake By Mouth	N.S.	0.407‡	1.146‡
Expression: Rarely Expresses	N.S.	2.457‡	1.401‡

(continued)

Table 11-6 (continued)
Separate HHA and inpatient PAC case-mix model of the total inpatient PAC stay/HHA episode routine/nursing resource intensity index

Variable	HHA Routine Stage 1 Pr(>0)	HHA Routine Stage 2 Intensity	Inpatient Routine Intensity
Expression: Frequent Difficulty	N.S.	0.830‡	N.S.
Expression: Some Difficulty	N.S.	N.S.	N.S.
Expression: No Difficulty (reference group)	—	—	—
Expression: Missing	N.S.	0.321‡	N.S.
Sitting Endurance: Cannot Do	N.S.	N.S.	N.S.
Sitting Endurance: Can Do W/ Support	N.S.	0.898§	0.928§
Sitting Endurance: Can Do Without Support (reference group)	—	—	—
Sitting Endurance: Missing	N.S.	N.S.	N.S.
Respiratory Status Any Impairment	2.208‡	N.S.	N.S.
Motor Function Rasch Score	0.918‡	1.022‡	N.S.
Motor Function Rasch Score-Squared	1.001‡	0.9997‡	0.9997‡
Comorbidity Index	N.S.	1.188‡	N.S.
Comorbidity Index-Squared	N.S.	0.990§	N.S.
Interaction: MF Rasch Score and Comorbidity Index	N.S.	N.S.	N.S.
Comorbidity Index Missing[1]	1.585‡	N.S.	N.S.

[1] The comorbidity index is calculated based on hospital diagnosis information in the 100 days prior to admission to the PAC setting. Consequently, there will be interaction between a missed comorbidity index and the presence of an acute stay in the last 2 months.

NOTE:

HHA–Inpatient PAC Setting Model: The HHA component is estimated as a two-part generalized linear model (GLM); the first stage is a GLM with logit link and binomial distribution of whether routine resource intensity is positive for the stay, and the second stage is a GLM with logarithmic link and Gaussian distribution of the level of total stay routine resource intensity if positive. The inpatient PAC component is a GLM with logarithmic link and Gaussian distribution of the level of total stay routine resource intensity.

Effects of each case-mix characteristic based on the components are multiplicative factors applied to the total stay routine resource intensity index; for example, a reported effect of 1.10 implies a 10 percent increase in resource intensity if a patient has that characteristic relative to if they do not, holding other characteristics fixed.

The following symbols indicate statistical significance of the estimated effects on total stay routine resource intensity: § indicates the factor is significant at the 10 percent significance level; ‡ indicates the factor is significant at the 5-percent significance level. “N.S.” indicates the effect is not statistically significant.

A total of 6,705 patient stays/episodes used in this analysis. Global MSE-based R^2 = 0.745.

COPD = chronic obstructive pulmonary disease; CRU = cost and resource utilization; DX = diagnosis; DX = primary or comorbid diagnosis; GI = gastrointestinal bleeding; HHA = home health agency; ICU = intensive care unit; MF=Motor Function; UTI = urinary tract infection.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-7
Setting-Specific inpatient PAC case-mix models of the total inpatient PAC stay routine/nursing resource intensity index

Variable	IRF Intensity	LTCH Intensity	SNF Intensity	SNF/IRF Intensity
64 years and under	1.386‡	0.844‡	N.S.	1.200‡
65-69 years	1.238‡	N.S.	N.S.	N.S.
70-74 years	1.174§	N.S.	N.S.	N.S.
75-79 years	N.S.	N.S.	N.S.	N.S.
80-84 years	N.S.	N.S.	N.S.	N.S.
85 years and above (reference group)	—	—	—	—
Acute Stay Past 2 Months	N.S.	1.160‡	11.819‡	N.S.
Number of Days in ICU	N.S.	1.013‡	N.S.	N.S.
Number of Days in ICU - Squared	N.S.	N.S.	N.S.	N.S.
Prim DX: Stroke (reference group)	—	—	—	—
Prim DX: Neurologic Surgical	N.S.	N.S.	N.S.	N.S.
Prim DX: Neurologic Medical	N.S.	1.484‡	N.S.	N.S.
Prim DX: Respiratory Surgical	N.S.	1.561‡	0.606‡	N.S.
Prim DX: Respiratory Medical	N.S.	1.392‡	N.S.	N.S.
Prim DX: COPD	0.534‡	1.344§	0.676‡	0.615‡
Prim DX: Vascular-Surgical	N.S.	1.533‡	N.S.	N.S.
Prim DX: Cardio-Surgical	0.769‡	1.329‡	0.667‡	0.734‡
Prim DX: Cardio-Vascular General	N.S.	N.S.	N.S.	N.S.
Prim DX: Vascular-Medical	N.S.	N.S.	0.248‡	N.S.
Prim DX: Cardio-Medical	0.772§	N.S.	N.S.	N.S.
Prim DX: Orthopedic Minor Surgical	0.827§	1.364§	N.S.	N.S.
Prim DX: Orthopedic Major Surgical	0.745‡	N.S.	0.582‡	0.691‡
Prim DX: Orthopedic - Head/Spine	N.S.	1.346§	0.567‡	N.S.
Prim DX: Orthopedic Minor Medical	0.584‡	N.S.	N.S.	N.S.
Prim DX: Orthopedic Major Medical	0.842§	N.S.	1.295§	N.S.
Prim DX: Integumentary Surgical	N.S.	1.348‡	N.S.	N.S.
Prim DX: Integumentary Medical	N.S.	N.S.	N.S.	N.S.
Prim DX: Endocrine Surgical	0.296‡	1.875‡	N.S.	N.S.
Prim DX: Endocrine Medical	N.S.	1.458§	N.S.	N.S.
Prim DX: Kidney Surgical	N.S.	2.216§	0.600‡	N.S.
Prim DX: Kidney Medical	0.694‡	1.280§	0.763§	0.717‡
Prim DX: Infectious Disease Surgical	N.S.	1.294‡	N.S.	N.S.
Prim DX: Infectious Disease Medical	N.S.	1.399‡	N.S.	N.S.
Prim DX: Septicemia	N.S.	1.502‡	N.S.	0.803§
Prim DX: Transplant	N.S.	2.226‡	N.S.	N.S.
Prim DX: GI Minor Surgical	0.733§	N.S.	0.527‡	0.702‡
Prim DX: GI Major Surgical	N.S.	1.709‡	0.704§	N.S.
Prim DX: GI Minor Medical	N.S.	1.254§	N.S.	N.S.

(continued)

Table 11-7 (continued)
Setting-Specific inpatient PAC case-mix models of the total inpatient PAC stay routine/nursing resource intensity index

Variable	IRF Intensity	LTCH Intensity	SNF Intensity	SNF/IRF Intensity
Prim DX: GI Major Medical	N.S.	N.S.	N.S.	N.S.
Prim DX: Hematology Surgical	0.662‡	N.S.	N.S.	N.S.
Prim DX: Hematology Medical	N.S.	N.S.	N.S.	N.S.
Prim DX: Other Surgical	N.S.	N.S.	N.S.	N.S.
Prim DX: Other Medical	0.680‡	N.S.	0.518‡	0.764§
Comorb DX: Morbid Obesity	N.S.	N.S.	N.S.	0.835§
Comorb DX: Endocrine and Metabolic	N.S.	N.S.	1.110‡	N.S.
Comorb DX: GI and Liver	N.S.	1.096‡	N.S.	N.S.
Comorb DX: Orthopedic	N.S.	N.S.	1.129§	N.S.
Comorb DX: Depression and Psych	N.S.	1.110‡	N.S.	N.S.
Comorb DX: Head/Spine	1.372‡	1.321‡	N.S.	1.431‡
Comorb DX: Neurologic (not stroke)	N.S.	N.S.	N.S.	0.902§
Comorb DX: Cardio-Vascular	N.S.	1.109‡	N.S.	N.S.
Comorb DX: Stroke	N.S.	N.S.	1.171‡	N.S.
Comorb DX: Respiratory	N.S.	1.117§	N.S.	N.S.
Comorb DX: Renal	1.185‡	1.112‡	0.706‡	N.S.
Comorb DX: Cellulitis	N.S.	1.177‡	1.340‡	1.149‡
Comorb DX: UTI	1.223‡	1.132‡	N.S.	1.172‡
Total Parenteral Nutrition	N.S.	1.235‡	N.S.	N.S.
Central Line Management	1.174‡	N.S.	1.499‡	1.248‡
Hemodialysis	N.S.	0.812‡	1.880‡	N.S.
Ventilator (weaning or non-weaning)	N.S.	1.368‡	2.478‡	N.S.
Indwelling Bowel Catheter	N.S.	N.S.	0.367‡	N.S.
Severe Pressure Ulcer	N.S.	1.396‡	N.S.	N.S.
Major Wound	N.S.	N.S.	1.209§	N.S.
Cognitive Status Severely Impaired	0.883§	0.846§	0.684‡	0.822‡
Cognitive Status Moderately Impaired	0.865‡	N.S.	N.S.	0.868‡
Cognitive Status Intact or Borderline (reference group)	—	—	—	—
Cognitive Status Missing	1.274§	N.S.	0.470‡	N.S.
Depressed Often or Always	N.S.	N.S.	N.S.	N.S.
Depressed Missing	0.880‡	N.S.	N.S.	0.880‡
Bladder Incontinence	1.121‡	N.S.	N.S.	1.118‡
Bowel Incontinence	N.S.	1.142‡	0.845§	N.S.
Swallowing Symptoms	N.S.	N.S.	0.800‡	N.S.
No Intake By Mouth	1.261‡	1.130§	N.S.	1.224‡
Expression: Rarely Expresses	1.208§	1.485‡	N.S.	1.212§
Expression: Frequent Difficulty	1.284‡	N.S.	N.S.	1.243‡

(continued)

Table 11-7 (continued)
Setting-Specific inpatient PAC case-mix models of the total inpatient PAC stay routine/nursing resource intensity index

Variable	IRF Intensity	LTCH Intensity	SNF Intensity	SNF/IRF Intensity
Expression: Some Difficulty	N.S.	N.S.	N.S.	N.S.
Expression: No Difficulty (reference group)	—	—	—	—
Expression: Missing	N.S.	N.S.	N.S.	N.S.
Sitting Endurance: Cannot Do	1.370§	N.S.	1.358‡	1.479‡
Sitting Endurance: Can Do W/ Support	N.S.	0.825‡	1.205‡	N.S.
Sitting Endurance: Can Do Without Support (reference group)	—	—	—	—
Sitting Endurance: Missing	1.264‡	N.S.	N.S.	N.S.
Respiratory Status Any Impairment	1.227‡	N.S.	N.S.	1.120‡
Motor Function Rasch Score	1.022‡	N.S.	1.070‡	1.034‡
Motor Function Rasch Score-Squared	0.9995‡	0.9998§	0.9986‡	0.999‡
Comorbidity Index	N.S.	N.S.	N.S.	N.S.
Comorbidity Index-Squared	N.S.	N.S.	N.S.	N.S.
Interaction: MF Rasch Score and Comorbidity Index	N.S.	N.S.	N.S.	N.S.
Comorbidity Index Missing[1]	N.S.	N.S.	N.S.	N.S.

[1] The comorbidity index is calculated based on hospital diagnosis information in the 100 days prior to admission to the PAC setting. Consequently, there will be interaction between a missed comorbidity index and the presence of an acute stay in the last 2 months.

NOTE:
Setting-Specific Model: The three separate inpatient PAC components use a GLM with logarithmic link and Gaussian distribution of the level of total stay routine resource intensity. The HHA components of the Setting-Specific model are not shown as they are identical to what is presented in the HHA part of the HHA–Inpatient PAC Settings Model.
HHA–LTCH–SNF/IRF Model: Coefficients associated with the prediction of RII in the combined SNF/IRF component are shown as calculated using GLM with logarithmic link and Gaussian distribution of the level of total stay routine resource intensity. The other components for this model are shown in the LTCH column of this table and the HHA columns in the previous table.
Effects of each case-mix characteristic based on the models are multiplicative factors applied to the total stay routine resource intensity index; for example, a reported effect of 1.10 implies a 10 percent increase in resource intensity if a patient has that characteristic relative to if they do not, holding other characteristics fixed.
The following symbols indicate statistical significance of the estimated effects on total stay routine resource intensity: § indicates the factor is significant at the 10 percent significance level; ‡ indicates the factor is significant at the 5-percent significance level. "N.S." indicates the effect is not statistically significant.
A total of 1,106 patient stays used in the IRF analysis, a total of 728 patient stays was used in the LTCH model, and a total of 800 patient stays was used in the SNF model. MSE-based R-squared was 0.424 in the IRF model, 0.645 in the LTCH model, 0.377 in the SNF model, and 0.320 in the SNF/IRF model.
COPD = chronic obstructive pulmonary disease; CRU = cost and resource utilization; DX = primary or comorbid diagnosis; GI = gastrointestinal bleeding; HHA = home health agency; ICU = intensive care unit; MF = Motor Function; UTI = urinary tract infection.
SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-8
Diagnostic Group-Specific inpatient PAC case-mix models of the total inpatient PAC stay routine/nursing resource intensity index

Variable	Neurologic Intensity	Orthopedic Intensity	Respiratory Intensity	Med/Surg Intensity
64 years and under	N.S.	N.S.	N.S.	N.S.
65-69 years	1.319‡	0.834§	1.240‡	N.S.
70-74 years	1.280§	N.S.	N.S.	N.S.
75-79 years	N.S.	N.S.	N.S.	0.762‡
80-84 years	N.S.	N.S.	1.302§	0.767‡
85 years and above (reference group)	—	—	—	—
Acute Stay Past 2 Months	N.S.	N.S.	2.203‡	0.786§
Number of Days in ICU	N.S.	1.144‡	1.011‡	1.022‡
Number of Days in ICU - Squared	N.S.	0.997‡	N.S.	N.S.
Prim DX: Stroke	Reference Group	N/A	N/A	N/A
Prim DX: Neurologic Surgical	N.S.	N/A	N/A	N/A
Prim DX: Neurologic Medical	N.S.	N/A	N/A	N/A
Prim DX: Respiratory Surgical	N/A	N/A	N.S.	N/A
Prim DX: Respiratory Medical	N/A	N/A	N.S.	N/A
Prim DX: COPD	N/A	N/A	Reference Group	N/A
Prim DX: Vascular-Surgical	N/A	N/A	N/A	1.369‡
Prim DX: Cardio-Surgical	N/A	N/A	N/A	N.S.
Prim DX: Cardio-Vascular General	N/A	N/A	N/A	N.S.
Prim DX: Vascular-Medical	N/A	N/A	N/A	N.S.
Prim DX: Cardio-Medical	N/A	N/A	N/A	N.S.
Prim DX: Orthopedic Minor Surgical	N/A	N.S.	N/A	N/A
Prim DX: Orthopedic Major Surgical	N/A	0.672‡	N/A	N/A
Prim DX: Orthopedic - Head/Spine	N/A	N.S.	N/A	N/A
Prim DX: Orthopedic Minor Medical	N/A	0.779§	N/A	N/A
Prim DX: Orthopedic Major Medical	N/A	Reference Group	N/A	N/A
Prim DX: Integumentary Surgical	N/A	N/A	N/A	1.959‡
Prim DX: Integumentary Medical	N/A	N/A	N/A	1.610‡
Prim DX: Endocrine Surgical	N/A	N/A	N/A	1.560§
Prim DX: Endocrine Medical	N/A	N/A	N/A	1.536‡
Prim DX: Kidney Surgical	N/A	N/A	N/A	1.942‡
Prim DX: Kidney Medical	N/A	N/A	N/A	N.S.
Prim DX: Infectious Disease Surgical	N/A	N/A	N/A	1.310‡
Prim DX: Infectious Disease Medical	N/A	N/A	N/A	1.439‡
Prim DX: Septicemia	N/A	N/A	N/A	1.377‡
Prim DX: Transplant	N/A	N/A	N/A	2.285‡
Prim DX: GI Minor Surgical	N/A	N/A	N/A	N.S.

(continued)

Table 11-8 (continued)
Diagnostic Group-Specific inpatient PAC case-mix models of the total inpatient PAC stay routine/nursing resource intensity index

Variable	Neurologic Intensity	Orthopedic Intensity	Respiratory Intensity	Med/Surg Intensity
Prim DX: GI Major Surgical	N/A	N/A	N/A	1.399‡
Prim DX: GI Minor Medical	N/A	N/A	N/A	1.346‡
Prim DX: GI Major Medical	N/A	N/A	N/A	1.376§
Prim DX: Hematology Surgical	N/A	N/A	N/A	N.S.
Prim DX: Hematology Medical	N/A	N/A	N/A	N.S.
Prim DX: Other Surgical	N/A	N/A	N/A	N.S.
Prim DX: Other Medical	N/A	N/A	N/A	Reference Group
Comorb DX: Morbid Obesity	N.S.	N.S.	N.S.	N.S.
Comorb DX: Endocrine and Metabolic	N.S.	N.S.	N.S.	N.S.
Comorb DX: GI and Liver	N.S.	N.S.	1.273‡	0.888§
Comorb DX: Orthopedic	1.186‡	N.S.	N.S.	N.S.
Comorb DX: Depression and Psych	N.S.	N.S.	N.S.	N.S.
Comorb DX: Head/Spine	N.S.	N.S.	1.476‡	N.S.
Comorb DX: Neurologic (not stroke)	N.S.	N.S.	N.S.	N.S.
Comorb DX: Cardio-Vascular	1.240‡	N.S.	N.S.	1.122‡
Comorb DX: Stroke	N.S.	1.338‡	N.S.	N.S.
Comorb DX: Respiratory	1.244‡	N.S.	N.S.	1.172‡
Comorb DX: Renal	N.S.	N.S.	1.152‡	1.224‡
Comorb DX: Cellulitis	1.443‡	N.S.	1.370‡	N.S.
Comorb DX: UTI	1.279‡	N.S.	1.159‡	1.322‡
Total Parenteral Nutrition	N.S.	1.783‡	1.305§	1.245‡
Central Line Management	N.S.	1.529‡	N.S.	1.162‡
Hemodialysis	N.S.	0.483‡	N.S.	N.S.
Ventilator (weaning or non-weaning)	N.S.	0.056‡	1.457‡	N.S.
Indwelling Bowel Catheter	N.S.	N.S.	N.S.	N.S.
Severe Pressure Ulcer	N.S.	1.364‡	1.415‡	1.160‡
Major Wound	N.S.	1.301‡	N.S.	1.239‡
Cognitive Status Severely Impaired	0.805§	0.821‡	N.S.	0.871§
Cognitive Status Moderately Impaired	0.839‡	0.824‡	N.S.	N.S.
Cognitive Status Intact or Borderline (reference group)	—	—	—	—
Cognitive Status Missing	N.S.	N.S.	N.S.	0.505‡
Depressed Often or Always	N.S.	1.167‡	N.S.	N.S.
Depressed Missing	N.S.	0.842‡	N.S.	N.S.
Bladder Incontinence	N.S.	1.158‡	N.S.	N.S.
Bowel Incontinence	N.S.	N.S.	1.147‡	1.263‡
Swallowing Symptoms	N.S.	N.S.	N.S.	N.S.
No Intake By Mouth	N.S.	N.S.	1.227§	N.S.
Expression: Rarely Expresses	1.480‡	1.691‡	1.409‡	1.539‡

(continued)

Table 11-8 (continued)
Diagnostic Group-Specific inpatient PAC case-mix models of the total inpatient PAC stay routine/nursing resource intensity index

Variable	Neurologic Intensity	Orthopedic Intensity	Respiratory Intensity	Med/Surg Intensity
Expression: Frequent Difficulty	1.479‡	1.319‡	N.S.	N.S.
Expression: Some Difficulty	N.S.	N.S.	N.S.	N.S.
Expression: No Difficulty (reference group)	—	—	—	—
Expression: Missing	N.S.	N.S.	N.S.	N.S.
Sitting Endurance: Cannot Do	1.420‡	1.372‡	N.S.	N.S.
Sitting Endurance: Can Do W/ Support	N.S.	N.S.	N.S.	N.S.
Sitting Endurance: Can Do Without Support (reference group)	—	—	—	—
Sitting Endurance: Missing	1.689‡	N.S.	N.S.	1.210‡
Respiratory Status Any Impairment	1.231‡	N.S.	N.S.	N.S.
Motor Function Rasch Score	1.018§	1.034‡	N.S.	N.S.
Motor Function Rasch Score-Squared	0.9995‡	0.999‡	N.S.	0.9998‡
Comorbidity Index	N.S.	N.S.	N.S.	N.S.
Comorbidity Index-Squared	1.015‡	0.986§	N.S.	N.S.
Interaction: MF Rasch Score and Comorbidity Index	N.S.	1.006‡	N.S.	N.S.
Comorbidity Index Missing[1]	N.S.	0.532§	1.864‡	N.S.

[1] The comorbidity index is calculated based on hospital diagnosis information in the 100 days prior to admission to the PAC setting. Consequently, there will be interaction between a missed comorbidity index and the presence of an acute stay in the last 2 months.

NOTE:

HHA–Inpatient PAC Diagnosis Group Model: The RII for each of the four categories of diagnoses in inpatient PAC settings was modeled as a GLM with logarithmic link and Gaussian distribution of the level of total stay routine resource intensity. The HHA components are not shown as they are identical to what is presented in the HHA part of the HHA–Inpatient PAC Settings Model.

Effects of each case-mix characteristic based on the models are multiplicative factors applied to the total stay routine resource intensity index; for example, a reported effect of 1.10 implies a 10 percent increase in resource intensity if a patient has that characteristic relative to if they do not, holding other characteristics fixed.

The following symbols indicate statistical significance of the estimated effects on total stay routine resource intensity: § indicates the factor is significant at the 10 percent significance level; ‡ indicates the factor is significant at the 5-percent significance level. “N.S.” indicates the effect is not statistically significant. “N/A” indicates that the primary diagnosis variable was not included in the model.

Cognitive Status was assessed through the Brief Interview for Mental Status (BIMS) and an observation assessment for patients who could not be interviewed.

A total of 1,044 patient stays used in the Med/Surg model, a total of 401 patient stays was used in the Neurologic model, a total of 756 patient stays was used in the Orthopedic model, and a total of 473 patient stays was used in the Respiratory model. MSE-based R-squared was 0.662 in the Med/Surg model, 0.350 in the Neurologic model, 0.415 in the Orthopedic model, and 0.714 in the Respiratory model.

COPD = chronic obstructive pulmonary disease; CRU = cost and resource utilization; DX = primary or comorbid diagnosis; GI = gastrointestinal bleeding; HHA = home health agency; ICU = intensive care unit; Med/Surg = Medical and Surgical, diagnoses, not otherwise categorized; MF = Motor Function; UTI = urinary tract infection.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-9
MSE-based R-squareds for the inpatient PAC stay/HHA episode therapy resource intensity index models

Model	Global	HHA	IRF	LTCH	SNF	Inpatient	SNF/ IRF	Neuro Diagnosis Groups	Ortho Diagnosis Groups	Resp Diagnosis Groups	Med/Surg Diagnosis Groups
All-PAC Settings[1]	0.281	−0.391	0.158	0.043	0.040	0.106	—	—	—	—	—
HHA–Inpatient PAC Settings[2]	0.356	0.179	0.186	0.028	0.129	0.155	—	—	—	—	—
HHA–LTCH–SNF/IRF[3]	0.387	0.179	0.225	0.237	0.132	0.200	0.177	—	—	—	—
HHA–Inpatient Diagnostic Groups[4]	0.460	0.179	0.301	0.130	0.329	0.305	—	0.299	0.347	0.307	0.174
Setting-Specific[5]	0.463	0.179	0.302	0.237	0.306	0.309	—	—	—	—	—

[1] The All-PAC Settings models are composed of two components: (1) a component predicting whether therapy services are used and (2) a component predicting the amount of services used if positive.

[2] The HHA–Inpatient PAC Settings models are composed of three components: (1) an HHA-only component predicting whether therapy services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) an inpatient PAC-only component predicting the amount of services used.

[3] The HHA–LTCH–SNF/IRF models are composed of four components: (1) an HHA-only component predicting whether therapy services are used, (2) an HHA-only component predicting the amount of services used if positive, (3) an LTCH-only component predicting the amount of services used; and (4) a combined SNF and IRF component predicting the amount of services used.

[4] The HHA–Inpatient Diagnostic Groups models are composed of six components: (1) an HHA-only component predicting whether therapy services are used; (2) an HHA-only component predicting the amount of services used if positive; (3-6) separate inpatient PAC-only components predicting the amount of services used for neurologic patients, orthopedic patients, respiratory patients, and patients with other medical/surgical primary diagnoses.

[5] The Setting-Specific models are composed of five components: (1) an HHA-only component predicting whether therapy services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) separate IRF-, LTCH-, and SNF-specific components predicting the amount of services used.

NOTE: All models include 6,705 patients in the analytic sample. All model variations examined in this table do not include setting indicators within the model components. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; Med/Surg = Medical/surgical diagnoses, not otherwise classified; MSE = mean-squared error; Neuro = neurological; Ortho = orthopedic; PAC = post-acute care; Resp = Respiratory; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-10
Ratio of predicted to actual therapy resource intensity index for the inpatient PAC stay/HHA episode therapy resource intensity index models, by setting

Model	HHA	IRF	LTCH	SNF
All-PAC Settings[1]	1.372	0.881	1.050	0.710
HHA–Inpatient PAC Settings[2]	1.000	1.008	1.118	0.908
HHA–LTCH–SNF/IRF[3]	1.000	1.044	1.000	0.934
HHA–Inpatient Diagnostic Groups[4]	1.000	1.007	1.091	0.928
Setting-Specific[5]	1.000	1.000	1.000	1.000

1 The All-PAC Settings models are composed of two components: (1) a component predicting whether therapy services are used and (2) a component predicting the amount of services used if positive.

2 The HHA–Inpatient PAC Settings models are composed of three components: (1) an HHA-only component predicting whether therapy services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) an inpatient PAC-only component predicting the amount of services used.

3 The HHA–LTCH–SNF/IRF models are composed of four components: (1) an HHA-only component predicting whether therapy services are used; (2) an HHA-only component predicting the amount of services used if positive; (3) an LTCH-only component predicting the amount of services used; and (4) a combined SNF and IRF component predicting the amount of services used.

4 The HHA–Inpatient Diagnostic Groups models are composed of six components: (1) an HHA-only component predicting whether therapy services are used; (2) an HHA-only component predicting the amount of services used if positive; (3-6) separate inpatient PAC-only components predicting the amount of services used for neurologic patients, orthopedic patients, respiratory patients, and patients with other medical/surgical primary diagnoses.

5 The Setting-Specific models are composed of five components: (1) an HHA-only component predicting whether therapy services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) separate IRF-, LTCH-, and SNF-specific components predicting the amount of services used.

NOTE: All models include 6,705 patients in the analytic sample. All model variations examined in this table do not include setting indicators within the model components. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MSE = mean-squared error; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-11
MSE-based R-squareds for the inpatient PAC stay/HHA episode therapy resource intensity index models, with and without setting indicators

Model	Setting indicators only	Patient acuity measures only	Setting & patient acuity measures
All-PAC Settings[1]	0.249	0.281	0.362
HHA–Inpatient PAC Settings[2]	0.249	0.356	0.371
HHA–LTCH–SNF/IRF[3]	0.249	0.387	0.391
HHA–Inpatient Diagnostic Groups[4]	0.249	0.460	0.477
Setting-Specific[5]	—	—	0.463

1 The All-PAC Settings models are composed of two components: (1) a component predicting whether therapy services are used and (2) a component predicting the amount of services used if positive.

2 The HHA–Inpatient PAC Settings models are composed of three components: (1) an HHA-only component predicting whether therapy services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) an inpatient PAC-only component predicting the amount of services used.

3 The HHA–LTCH–SNF/IRF models are composed of four components: (1) an HHA-only component predicting whether therapy services are used; (2) an HHA-only component predicting the amount of services used if positive; (3) an LTCH-only component predicting the amount of services used; and (4) a combined SNF and IRF component predicting the amount of services used.

4 The HHA–Inpatient Diagnostic Groups models are composed of six components: (1) an HHA-only component predicting whether therapy services are used; (2) an HHA-only component predicting the amount of services used if positive; (3-6) separate inpatient PAC-only components predicting the amount of services used for neurologic patients, orthopedic patients, respiratory patients, and patients with other medical/surgical primary diagnoses.

5 The Setting-Specific models are composed of five components: (1) an HHA-only component predicting whether therapy services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) separate IRF-, LTCH-, and SNF-specific components predicting the amount of services used.

NOTE: All models include 6,705 patients in the analytic sample. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MSE = mean-squared error; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-12
Separate HHA and inpatient PAC case-mix model of the total inpatient PAC stay/HHA episode therapy resource intensity index

Variable	HHA therapy Stage 1 Pr(>0)	HHA therapy Stage 2 Intensity	Inpatient therapy Intensity
64 years and under	0.396‡	N.S.	N.S.
65-69 years	0.450‡	N.S.	N.S.
70-74 years	0.555‡	N.S.	N.S.
75-79 years	0.715‡	N.S.	N.S.
80-84 years	N.S.	N.S.	N.S.
85 years and above (reference group)	—	—	—
Acute Stay Past 2 Months	1.946‡	0.852‡	N.S.
Number of Days in ICU	N.S.	N.S.	0.990‡
Number of Days in ICU - Squared	N.S.	N.S.	1.0002‡
Prim DX: Stroke (reference group)	—	—	—
Prim DX: Neurologic Surgical	0.222‡	N.S.	N.S.
Prim DX: Neurologic Medical	0.298§	0.735‡	N.S.
Prim DX: Respiratory Surgical	0.078‡	0.597‡	N.S.
Prim DX: Respiratory Medical	0.083‡	0.729‡	0.634‡
Prim DX: COPD	0.083‡	0.663‡	0.449‡
Prim DX: Vascular-Surgical	0.035‡	0.618‡	N.S.
Prim DX: Cardio-Surgical	0.047‡	0.632‡	0.645‡
Prim DX: Cardio-Vascular General	0.099‡	0.512‡	N.S.
Prim DX: Vascular-Medical	0.089‡	0.598‡	0.620‡
Prim DX: Cardio-Medical	0.075‡	0.612‡	0.669‡
Prim DX: Orthopedic Minor Surgical	N.S.	0.691‡	0.801§
Prim DX: Orthopedic Major Surgical	N.S.	0.736‡	0.560‡
Prim DX: Orthopedic - Head/Spine	0.276‡	0.618‡	N.S.
Prim DX: Orthopedic Minor Medical	N.S.	0.662‡	N.S.
Prim DX: Orthopedic Major Medical	0.204‡	0.648‡	N.S.
Prim DX: Integumentary Surgical	0.022‡	0.328‡	0.532‡
Prim DX: Integumentary Medical	0.047‡	0.569‡	N.S.
Prim DX: Endocrine Surgical	0.071‡	N.S.	N.S.

(continued)

Table 11-12 (continued)
Separate HHA and inpatient PAC case-mix model of the total inpatient PAC stay/HHA episode therapy resource intensity index

Variable	HHA therapy Stage 1 Pr(>0)	HHA therapy Stage 2 Intensity	Inpatient therapy Intensity
Prim DX: Endocrine Medical	0.106‡	0.720‡	N.S.
Prim DX: Kidney Surgical	0.025‡	0.637§	0.648‡
Prim DX: Kidney Medical	0.068‡	0.678‡	0.605‡
Prim DX: Infectious Disease Surgical	0.119‡	0.420‡	0.604‡
Prim DX: Infectious Disease Medical	0.216§	0.481‡	N.S.
Prim DX: Septicemia	0.079‡	N.S.	0.626‡
Prim DX: Transplant	0.040‡	0.175‡	N.S.
Prim DX: GI Minor Surgical	0.078‡	0.475‡	0.623‡
Prim DX: GI Major Surgical	0.053‡	0.475‡	N.S.
Prim DX: GI Minor Medical	0.087‡	0.607‡	0.682§
Prim DX: GI Major Medical	0.114‡	0.638‡	N.S.
Prim DX: Hematology Surgical	0.133§	N.S.	0.395‡
Prim DX: Hematology Medical	0.052‡	0.516‡	N.S.
Prim DX: Other Surgical	0.080‡	0.585‡	0.677‡
Prim DX: Other Medical	0.218‡	0.726‡	0.783§
Comorb DX: Morbid Obesity	N.S.	N.S.	0.862§
Comorb DX: Endocrine and Metabolic	N.S.	N.S.	N.S.
Comorb DX: GI and Liver	N.S.	N.S.	N.S.
Comorb DX: Orthopedic	1.698‡	N.S.	N.S.
Comorb DX: Depression and Psych	N.S.	N.S.	N.S.
Comorb DX: Head/Spine	N.S.	N.S.	1.232‡
Comorb DX: Neurologic (not stroke)	N.S.	1.107§	0.890§
Comorb DX: Cardio-Vascular	N.S.	1.091§	N.S.
Comorb DX: Stroke	2.919‡	1.166‡	1.216‡
Comorb DX: Respiratory	N.S.	N.S.	N.S.
Comorb DX: Renal	N.S.	N.S.	N.S.
Comorb DX: Cellulitis	N.S.	N.S.	N.S.
Comorb DX: UTI	N.S.	N.S.	N.S.

(continued)

Table 11-12 (continued)
Separate HHA and inpatient PAC case-mix model of the total inpatient PAC stay/HHA episode therapy resource intensity index

Variable	HHA therapy Stage 1 Pr(>0)	HHA therapy Stage 2 Intensity	Inpatient therapy Intensity
Total Parenteral Nutrition	N.S.	0.079‡	0.833§
Central Line Management	0.349‡	N.S.	0.850‡
Hemodialysis	N.S.	N.S.	0.670‡
Ventilator (weaning or non-weaning)	N.S.	0.246‡	N.S.
Indwelling Bowel Catheter	N.S.	0.372§	N.S.
Severe Pressure Ulcer	N.S.	N.S.	N.S.
Major Wound	0.587‡	N.S.	N.S.
Cognitive Status Severely Impaired	N.S.	0.881‡	N.S.
Cognitive Status Moderately Impaired	N.S.	N.S.	N.S.
Cognitive Status Intact or Borderline (reference group)	—	—	—
Cognitive Status Missing	N.S.	N.S.	N.S.
Depressed Often or Always	N.S.	N.S.	N.S.
Depressed Missing	N.S.	N.S.	0.826‡
Bladder Incontinence	N.S.	N.S.	N.S.
Bowel Incontinence	0.668§	N.S.	N.S.
Swallowing Symptoms	N.S.	1.265‡	N.S.
No Intake By Mouth	N.S.	N.S.	N.S.
Expression: Rarely Expresses	N.S.	0.689§	1.203§
Expression: Frequent Difficulty	N.S.	N.S.	N.S.
Expression: Some Difficulty	N.S.	N.S.	N.S.
Expression: No Difficulty (reference group)	—	—	—
Expression: Missing	0.271‡	0.520‡	N.S.
Sitting Endurance: Cannot Do	N.S.	N.S.	N.S.
Sitting Endurance: Can Do W/ Support	N.S.	N.S.	N.S.
Sitting Endurance: Can Do Without Support (reference group)	—	—	—
Sitting Endurance: Missing	—	0.797§	0.831§
Respiratory Status Any Impairment	0.806§	0.875‡	N.S.

(continued)

Table 11-12 (continued)
Separate HHA and inpatient PAC case-mix model of the total inpatient PAC stay/HHA episode therapy resource intensity index

Variable	HHA therapy Stage 1 Pr(>0)	HHA therapy Stage 2 Intensity	Inpatient therapy Intensity
Motor Function Rasch Score	N.S.	N.S.	1.033‡
Motor Function Rasch Score-Squared	0.9995‡	0.9999‡	0.999‡
Comorbidity Index	N.S.	1.102§	N.S.
Comorbidity Index-Squared	N.S.	N.S.	N.S.
Interaction: MF Rasch Score and Comorbidity Index	1.002§	0.998‡	N.S.
Comorbidity Index Missing[1]	N.S.	N.S.	N.S.

[1] The comorbidity index is calculated based on hospital diagnosis information in the 100 days prior to admission to the PAC setting. Consequently, there will be interaction between a missed comorbidity index and the presence of an acute stay in the last 2 months.

NOTE:

HHA–Inpatient PAC Setting Model: The HHA component is estimated as a two-part generalized linear model (GLM); the first stage is a GLM with logit link and binomial distribution of whether therapy resource intensity is positive for the stay, and the second stage is a GLM with logarithmic link and Gaussian distribution of the level of total stay therapy resource intensity if positive. The inpatient PAC component is a GLM with logarithmic link and Gaussian distribution of the level of total stay therapy resource intensity.

Effects of each case-mix characteristic based on the models are multiplicative factors applied to the total stay therapy resource intensity index; for example, a reported effect of 1.10 implies a 10 percent increase in resource intensity if a patient has that characteristic relative to if they do not, holding other characteristics fixed.

The following symbols indicate statistical significance of the estimated effects on total stay therapy resource intensity: § indicates the factor is significant at the 10 percent significance level; ‡ indicates the factor is significant at the 5-percent significance level. "N.S." indicates the effect is not statistically significant.

A total of 6,705 patient stays used in this analysis. Global MSE-based $R^2 = 0.356$.

COPD = chronic obstructive pulmonary disease; CRU = cost and resource utilization; DX = primary or comorbid diagnosis; GI = gastrointestinal bleeding; HHA = home health agency; ICU = intensive care unit; MF = Motor Function; UTI = urinary tract infection.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-13
Setting-Specific inpatient PAC case-mix models of the total inpatient PAC stay therapy resource intensity index

Variable	IRF Intensity	LTCH Intensity	SNF Intensity	SNF/IRF Intensity
64 years and under	1.382‡	N.S.	1.321‡	N.S.
65-69 years	1.317‡	1.322‡	N.S.	N.S.
70-74 years	1.230§	N.S.	N.S.	N.S.
75-79 years	N.S.	1.584‡	0.697§	N.S.
80-84 years	N.S.	N.S.	N.S.	N.S.
85 years and above (reference group)	—	—	—	—
Acute Stay Past 2 Months	N.S.	N.S.	6.740‡	N.S.
Number of Days in ICU	0.891§	0.987‡	N.S.	N.S.
Number of Days in ICU - Squared	N.S.	1.0002‡	N.S.	N.S.
Prim DX: Stroke (reference group)	—	—	—	—
Prim DX: Neurologic Surgical	N.S.	0.605‡	N.S.	N.S.
Prim DX: Neurologic Medical	N.S.	N.S.	N.S.	N.S.
Prim DX: Respiratory Surgical	N.S.	N.S.	0.262‡	N.S.
Prim DX: Respiratory Medical	0.719§	N.S.	0.425‡	0.677‡
Prim DX: COPD	0.249‡	N.S.	0.167‡	0.387‡
Prim DX: Vascular-Surgical	0.712‡	N.S.	N.S.	N.S.
Prim DX: Cardio-Surgical	0.601‡	N.S.	0.396‡	0.667‡
Prim DX: Cardio-Vascular General	N.S.	N.S.	N.S.	N.S.
Prim DX: Vascular-Medical	0.439§	N.S.	0.311‡	0.582§
Prim DX: Cardio-Medical	0.469‡	N.S.	0.503‡	0.688§
Prim DX: Orthopedic Minor Surgical	0.638‡	N.S.	N.S.	0.801§
Prim DX: Orthopedic Major Surgical	0.607‡	N.S.	0.379‡	0.561‡
Prim DX: Orthopedic - Head/Spine	N.S.	N.S.	0.510‡	N.S.
Prim DX: Orthopedic Minor Medical	0.516‡	N.S.	N.S.	N.S.
Prim DX: Orthopedic Major Medical	0.721§	N.S.	N.S.	N.S.
Prim DX: Integumentary Surgical	N.S.	N.S.	N.S.	N.S.
Prim DX: Integumentary Medical	0.487‡	0.601§	N.S.	N.S.
Prim DX: Endocrine Surgical	0.389§	1.637‡	N.S.	N.S.
Prim DX: Endocrine Medical	N.S.	N.S.	0.547‡	N.S.

(continued)

Table 11-13 (continued)
Setting-Specific inpatient PAC case-mix models of the total inpatient PAC stay therapy resource intensity index

Variable	IRF Intensity	LTCH Intensity	SNF Intensity	SNF/IRF Intensity
Prim DX: Kidney Surgical	N.S.	N.S.	0.422‡	N.S.
Prim DX: Kidney Medical	0.660‡	0.549‡	0.521‡	0.641‡
Prim DX: Infectious Disease Surgical	N.S.	N.S.	N.S.	0.639§
Prim DX: Infectious Disease Medical	0.388‡	N.S.	N.S.	N.S.
Prim DX: Septicemia	0.669‡	N.S.	0.169‡	0.563‡
Prim DX: Transplant	N.S.	N.S.	0.550§	N.S.
Prim DX: GI Minor Surgical	N.S.	N.S.	0.371‡	0.671‡
Prim DX: GI Major Surgical	N.S.	0.629‡	N.S.	N.S.
Prim DX: GI Minor Medical	N.S.	0.416‡	0.355§	N.S.
Prim DX: GI Major Medical	1.392§	0.503‡	N.S.	N.S.
Prim DX: Hematology Surgical	0.383‡	N.S.	0.502‡	0.377‡
Prim DX: Hematology Medical	0.664§	0.026‡	0.158‡	N.S.
Prim DX: Other Surgical	0.685‡	N.S.	N.S.	0.755‡
Prim DX: Other Medical	0.695‡	0.656‡	0.272‡	N.S.
Comorb DX: Morbid Obesity	N.S.	N.S.	0.131‡	N.S.
Comorb DX: Endocrine and Metabolic	N.S.	N.S.	1.304‡	N.S.
Comorb DX: GI and Liver	N.S.	1.236‡	0.566‡	N.S.
Comorb DX: Orthopedic	N.S.	N.S.	1.401‡	N.S.
Comorb DX: Depression and Psych	0.869§	N.S.	N.S.	N.S.
Comorb DX: Head/Spine	1.280‡	N.S.	N.S.	1.271‡
Comorb DX: Neurologic (not stroke)	N.S.	0.883§	0.601‡	0.852‡
Comorb DX: Cardio-Vascular	1.180‡	N.S.	0.502‡	N.S.
Comorb DX: Stroke	N.S.	N.S.	1.477‡	1.216§
Comorb DX: Respiratory	N.S.	N.S.	N.S.	N.S.
Comorb DX: Renal	N.S.	N.S.	1.328§	N.S.
Comorb DX: Cellulitis	N.S.	1.225‡	N.S.	N.S.
Comorb DX: UTI	1.242‡	N.S.	0.555‡	1.141§
Total Parenteral Nutrition	0.508‡	N.S.	0.016‡	0.465‡
Central Line Management	N.S.	N.S.	0.063‡	N.S.

(continued)

Table 11-13 (continued)
Setting-Specific inpatient PAC case-mix models of the total inpatient PAC stay therapy resource intensity index

Variable	IRF Intensity	LTCH Intensity	SNF Intensity	SNF/IRF Intensity
Hemodialysis	0.715‡	0.692‡	N.S.	0.717§
Ventilator (weaning or non-weaning)	0.402‡	N.S.	N.S.	N.S.
Indwelling Bowel Catheter	N.S.	N.S.	0.352‡	N.S.
Severe Pressure Ulcer	N.S.	N.S.	1.763‡	N.S.
Major Wound	N.S.	N.S.	N.S.	N.S.
Cognitive Status Severely Impaired	N.S.	N.S.	0.740‡	N.S.
Cognitive Status Moderately Impaired	N.S.	N.S.	1.213‡	N.S.
Cognitive Status Intact or Borderline (reference group)	—	—	—	—
Cognitive Status Missing	N.S.	N.S.	0.194‡	N.S.
Depressed Often or Always	N.S.	N.S.	N.S.	N.S.
Depressed Missing	0.757‡	0.780‡	N.S.	N.S.
Bladder Incontinence	N.S.	N.S.	1.383‡	N.S.
Bowel Incontinence	N.S.	1.216‡	N.S.	N.S.
Swallowing Symptoms	N.S.	1.163‡	N.S.	N.S.
No Intake By Mouth	N.S.	1.229‡	3.037‡	N.S.
Expression: Rarely Expresses	N.S.	N.S.	2.031‡	N.S.
Expression: Frequent Difficulty	N.S.	N.S.	N.S.	N.S.
Expression: Some Difficulty	N.S.	N.S.	0.687‡	N.S.
Expression: No Difficulty (reference group)	—	—	—	—
Expression: Missing	N.S.	N.S.	2.598§	N.S.
Sitting Endurance: Cannot Do	1.397‡	N.S.	N.S.	1.395‡
Sitting Endurance: Can Do W/ Support	N.S.	N.S.	1.652‡	N.S.
Sitting Endurance: Can Do Without Support (reference group)	—	—	—	—
Sitting Endurance: Missing	1.477‡	0.662‡	N.S.	N.S.
Respiratory Status Any Impairment	N.S.	N.S.	N.S.	N.S.
Motor Function Rasch Score	1.023‡	N.S.	1.079‡	1.039‡
Motor Function Rasch Score-Squared	0.999‡	0.9997‡	0.999‡	0.999‡

(continued)

Table 11-13 (continued)
Setting-Specific inpatient PAC case-mix models of the total inpatient PAC stay therapy resource intensity index

Variable	IRF Intensity	LTCH Intensity	SNF Intensity	SNF/IRF Intensity
Comorbidity Index	N.S.	N.S.	N.S.	N.S.
Comorbidity Index-Squared	N.S.	N.S.	0.957‡	N.S.
Interaction: MF Rasch Score and Comorbidity Index	N.S.	N.S.	N.S.	N.S.
Comorbidity Index Missing[1]	N.S.	N.S.	N.S.	N.S.

[1] The comorbidity index is calculated based on hospital diagnosis information in the 100 days prior to admission to the PAC setting. Consequently, there will be interaction between a missed comorbidity index and the presence of an acute stay in the last 2 months.

NOTE:

Setting-Specific Model: The three separate inpatient PAC components use a GLM with logarithmic link and Gaussian distribution of the level of total stay therapy resource intensity. The HHA components of the Setting-Specific model are not shown as they are identical to what is presented in the HHA part of the HHA–Inpatient PAC Settings Model.

HHA–LTCH–SNF/IRF Model: Coefficients associated with the prediction of RII in the combined SNF/IRF component are shown as calculated using GLM with logarithmic link and Gaussian distribution of the level of total stay therapy resource intensity. The other components for this model are shown in the LTCH column of this table and the HHA columns in the previous table.

Effects of each case-mix characteristic based on the models are multiplicative factors applied to the total stay therapy resource intensity index; for example, a reported effect of 1.10 implies a 10 percent increase in resource intensity if a patient has that characteristic relative to if they do not, holding other characteristics fixed.

The following symbols indicate statistical significance of the estimated effects on total stay therapy resource intensity: § indicates the factor is significant at the 10 percent significance level; ‡ indicates the factor is significant at the 5-percent significance level. "N.S." indicates the effect is not statistically significant.

A total of 1,106 patient stays used in the IRF model, a total of 728 patient stays was used in the LTCH model, and a total of 800 patient stays was used in the SNF model. MSE-based R-squared was 0.302 in the IRF model, 0.237 in the LTCH model, 0.306 in the SNF model, and 0.177 in the SNF/IRF model.

COPD = chronic obstructive pulmonary disease; CRU = cost and resource utilization; DX = primary or comorbid diagnosis; GI = gastrointestinal bleeding; HHA = home health agency; ICU = intensive care unit; MF = Motor Function; UTI = urinary tract infection.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-14
Diagnostic Group-Specific inpatient PAC case-mix models of the total inpatient PAC stay therapy resource intensity index

Variable	Neurologic Intensity	Orthopedic Intensity	Respiratory Intensity	Med/Surg Intensity
64 years and under	N.S.	N.S.	N.S.	N.S.
65-69 years	1.299§	0.602‡	1.438‡	1.307‡
70-74 years	N.S.	N.S.	N.S.	N.S.
75-79 years	N.S.	0.732‡	1.460‡	N.S.
80-84 years	N.S.	N.S.	N.S.	N.S.
85 years and above (reference group)	—	—	—	—
Acute Stay Past 2 Months	N.S.	4.250‡	6.250‡	0.585‡
Number of Days in ICU	N.S.	N.S.	0.987‡	0.985‡
Number of Days in ICU - Squared	N.S.	N.S.	1.0002‡	1.0002‡
Prim DX: Stroke	Reference Group	N/A	N/A	N/A
Prim DX: Neurologic Surgical	N.S.	N/A	N/A	N/A
Prim DX: Neurologic Medical	0.770‡	N/A	N/A	N/A
Prim DX: Respiratory Surgical	N/A	N/A	2.226‡	N/A
Prim DX: Respiratory Medical	N/A	N/A	1.580‡	N/A
Prim DX: COPD	N/A	N/A	Reference Group	N/A
Prim DX: Vascular-Surgical	N/A	N/A	N/A	1.470‡
Prim DX: Cardio-Surgical	N/A	N/A	N/A	N.S.
Prim DX: Cardio-Vascular General	N/A	N/A	N/A	N.S.
Prim DX: Vascular-Medical	N/A	N/A	N/A	N.S.
Prim DX: Cardio-Medical	N/A	N/A	N/A	N.S.
Prim DX: Orthopedic Minor Surgical	N/A	0.664‡	N/A	N/A
Prim DX: Orthopedic Major Surgical	N/A	0.438‡	N/A	N/A
Prim DX: Orthopedic - Head/Spine	N/A	N.S.	N/A	N/A
Prim DX: Orthopedic Minor Medical	N/A	N.S.	N/A	N/A
Prim DX: Orthopedic Major Medical	N/A	Reference Group	N/A	N/A
Prim DX: Integumentary Surgical	N/A	N/A	N/A	N.S.
Prim DX: Integumentary Medical	N/A	N/A	N/A	N.S.
Prim DX: Endocrine Surgical	N/A	N/A	N/A	1.787‡

(continued)

Table 11-14 (continued)
Diagnostic Group-Specific inpatient PAC case-mix models of the total inpatient PAC stay therapy resource intensity index

Variable	Neurologic Intensity	Orthopedic Intensity	Respiratory Intensity	Med/Surg Intensity
Prim DX: Endocrine Medical	N/A	N/A	N/A	1.761‡
Prim DX: Kidney Surgical	N/A	N/A	N/A	N.S.
Prim DX: Kidney Medical	N/A	N/A	N/A	N.S.
Prim DX: Infectious Disease Surgical	N/A	N/A	N/A	N.S.
Prim DX: Infectious Disease Medical	N/A	N/A	N/A	N.S.
Prim DX: Septicemia	N/A	N/A	N/A	N.S.
Prim DX: Transplant	N/A	N/A	N/A	N.S.
Prim DX: GI Minor Surgical	N/A	N/A	N/A	N.S.
Prim DX: GI Major Surgical	N/A	N/A	N/A	N.S.
Prim DX: GI Minor Medical	N/A	N/A	N/A	N.S.
Prim DX: GI Major Medical	N/A	N/A	N/A	N.S.
Prim DX: Hematology Surgical	N/A	N/A	N/A	0.646§
Prim DX: Hematology Medical	N/A	N/A	N/A	N.S.
Prim DX: Other Surgical	N/A	N/A	N/A	N.S.
Prim DX: Other Medical	N/A	N/A	N/A	Reference Group
Comorb DX: Morbid Obesity	N.S.	N.S.	N.S.	N.S.
Comorb DX: Endocrine and Metabolic	N.S.	N.S.	0.855§	N.S.
Comorb DX: GI and Liver	N.S.	0.606‡	1.270‡	N.S.
Comorb DX: Orthopedic	N.S.	1.319‡	N.S.	N.S.
Comorb DX: Depression and Psych	0.842§	N.S.	N.S.	N.S.
Comorb DX: Head/Spine	N.S.	2.654‡	1.660‡	1.660‡
Comorb DX: Neurologic (not stroke)	0.759‡	0.637‡	0.801‡	0.817‡
Comorb DX: Cardio-Vascular	1.307‡	0.643‡	1.173§	0.863‡
Comorb DX: Stroke	N.S.	2.095‡	1.284‡	1.180§
Comorb DX: Respiratory	1.367‡	N.S.	N.S.	N.S.
Comorb DX: Renal	N.S.	1.579‡	0.768‡	N.S.
Comorb DX: Cellulitis	N.S.	0.430‡	1.523‡	N.S.
Comorb DX: UTI	1.303‡	N.S.	N.S.	N.S.

(continued)

Table 11-14 (continued)
Diagnostic Group-Specific inpatient PAC case-mix models of the total inpatient PAC stay therapy resource intensity index

Variable	Neurologic Intensity	Orthopedic Intensity	Respiratory Intensity	Med/Surg Intensity
Total Parenteral Nutrition	0.537‡	0.095‡	0.746‡	N.S.
Central Line Management	N.S.	0.649‡	N.S.	0.772‡
Hemodialysis	0.668‡	0.439‡	N.S.	0.711‡
Ventilator (weaning or non-weaning)	0.412§	0.072‡	N.S.	N.S.
Indwelling Bowel Catheter	N.S.	0.448‡	N.S.	1.667‡
Severe Pressure Ulcer	N.S.	N.S.	N.S.	N.S.
Major Wound	N.S.	1.702‡	N.S.	N.S.
Cognitive Status Severely Impaired	N.S.	0.731§	N.S.	N.S.
Cognitive Status Moderately Impaired	N.S.	N.S.	N.S.	N.S.
Cognitive Status Intact or Borderline (reference group)	—	—	—	—
Cognitive Status Missing	N.S.	N.S.	N.S.	N.S.
Depressed Often or Always	N.S.	N.S.	N.S.	N.S.
Depressed Missing	0.608‡	N.S.	0.770§	N.S.
Bladder Incontinence	N.S.	N.S.	1.393‡	N.S.
Bowel Incontinence	N.S.	N.S.	1.233‡	N.S.
Swallowing Symptoms	N.S.	0.229‡	N.S.	N.S.
No Intake By Mouth	N.S.	N.S.	1.221‡	1.212§
Expression: Rarely Expresses	1.470‡	3.361‡	N.S.	1.511‡
Expression: Frequent Difficulty	1.339‡	2.248‡	N.S.	N.S.
Expression: Some Difficulty	N.S.	N.S.	1.267‡	N.S.
Expression: No Difficulty (reference group)	—	—	—	—
Expression: Missing	2.223‡	0.475‡	N.S.	0.238‡
Sitting Endurance: Cannot Do	1.279§	N.S.	0.695‡	N.S.
Sitting Endurance: Can Do W/ Support	N.S.	1.412‡	N.S.	N.S.
Sitting Endurance: Can Do Without Support (reference group)	—	—	—	—
Sitting Endurance: Missing	1.525‡	N.S.	0.421‡	N.S.
Respiratory Status Any Impairment	N.S.	N.S.	N.S.	1.236‡
Motor Function Rasch Score	1.045‡	1.041‡	1.032‡	1.036‡

(continued)

Table 11-14 (continued)
Diagnostic Group-Specific inpatient PAC case-mix models of the total inpatient PAC stay therapy resource intensity index

Variable	Neurologic Intensity	Orthopedic Intensity	Respiratory Intensity	Med/Surg Intensity
Motor Function Rasch Score-Squared	0.999‡	0.999‡	0.9995‡	0.999‡
Comorbidity Index	N.S.	N.S.	1.13§	0.876‡
Comorbidity Index-Squared	N.S.	0.959‡	0.994§	1.012‡
Interaction: MF Rasch Score and Comorbidity Index	N.S.	N.S.	0.997‡	N.S.
Comorbidity Index Missing[1]	5.675‡	N.S.	8.395‡	N.S.

[1] The comorbidity index is calculated based on hospital diagnosis information in the 100 days prior to admission to the PAC setting. Consequently, there will be interaction between a missed comorbidity index and the presence of an acute stay in the last 2 months.

NOTE: HHA–Inpatient PAC Diagnosis Group Model: The RII for each of the four categories of diagnoses in inpatient PAC settings was modeled as a GLM with logarithmic link and Gaussian distribution of the level of total stay therapy resource intensity. The HHA components are not shown as they are identical to what is presented in the HHA part of the HHA–Inpatient PAC Settings Model.

Effects of each case-mix characteristic based on the models are multiplicative factors applied to the total stay therapy resource intensity index; for example, a reported effect of 1.10 implies a 10 percent increase in resource intensity if a patient has that characteristic relative to if they do not, holding other characteristics fixed.

The following symbols indicate statistical significance of the estimated effects on total stay therapy resource intensity: § indicates the factor is significant at the 10 percent significance level; ‡ indicates the factor is significant at the 5-percent significance level. “N.S.” indicates the effect is not statistically significant. “N/A” indicates that the primary diagnosis variable was not included in the model.

A total of 1,004 patient stays used in the Med/Surg model, a total of 401 patient stays was used in the Neurologic model, a total of 756 patient stays was used in the Orthopedic model, and a total of 473 patient stays was used in the Respiratory model. MSE-based R-squared was 0.174 in the Med/Surg model, 0.299 in the Neurologic model, 0.347 in the Orthopedic model, and 0.307 in the Respiratory model.

COPD = chronic obstructive pulmonary disease; CRU = cost and resource utilization; DX = primary or comorbid diagnosis; GI = gastrointestinal bleeding; HHA = home health agency; ICU = intensive care unit; Med/Surg = Medical and Surgical diagnoses, not otherwise categorized; MF = Motor Function; UTI = urinary tract infection.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-15
MSE-based R-squareds for weighted inpatient PAC stay/HHA episode routine resource intensity index models

Model	Global	HHA	IRF	LTCH	SNF	Inpatient	SNF/ IRF	Neuro Diagnosis Groups	Ortho Diagnosis Groups	Resp Diagnosis Groups	Med/Surg Diagnosis Groups
All-PAC Settings[1]	0.543	−4.028	0.017	0.488	0.213	0.436	—	—	—	—	—
HHA–Inpatient PAC Settings[2]	0.650	0.141	0.140	0.545	0.293	0.496	—	—	—	—	—
HHA–LTCH–SNF/IRF[3]	0.691	0.141	−0.055	0.645	0.371	0.558	0.341	—	—	—	—
HHA–Inpatient Diagnostic Groups[4]	0.719	0.141	−0.146	0.617	0.491	0.599	—	0.471	0.491	0.729	0.487
Setting-Specific[5]	0.705	0.141	0.424	0.645	0.377	0.578	—	—	—	—	—

1 The All-PAC Settings models are composed of two components: (1) a component predicting whether routine services are used and (2) a component predicting the amount of services used if positive.

2 The HHA–Inpatient PAC Settings models are composed of three components: (1) an HHA-only component predicting whether routine services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) an inpatient PAC-only component predicting the amount of services used.

3 The HHA–LTCH–SNF/IRF models are composed of four components: (1) an HHA-only component predicting whether routine services are used, (2) an HHA-only component predicting the amount of services used if positive, (3) an LTCH-only component predicting the amount of services used; and (4) a combined SNF and IRF component predicting the amount of services used.

4 The HHA–Inpatient Diagnostic Groups models are composed of six components: (1) an HHA-only component predicting whether routine services are used; (2) an HHA-only component predicting the amount of services used if positive; (3-6) separate inpatient PAC-only components predicting the amount of services used for neurologic patients, orthopedic patients, respiratory patients, and patients with other medical/surgical primary diagnoses.

5 The Setting-Specific models are composed of five components: (1) an HHA-only component predicting whether routine services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) separate IRF-, LTCH-, and SNF-specific components predicting the amount of services used.

NOTE: All models include 6,705 patients in the analytic sample. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; Med/Surg = Medical/surgical diagnoses, not otherwise categorized; MSE = mean-squared error; Neuro = neurological; Ortho = orthopedic; PAC = post-acute care; Resp = Respiratory; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-16
MSE-based R-squareds for weighted inpatient PAC stay/HHA episode therapy resource intensity index models

Model	Global	HHA	IRF	LTCH	SNF	Inpatient	SNF/ IRF	Neuro Diagnosis Groups	Ortho Diagnosis Groups	Resp Diagnosis Groups	Med/Surg Diagnosis Groups
All-PAC Settings[1]	0.278	−1.241	−0.270	−0.346	0.237	0.205	—	—	—	—	—
HHA–Inpatient PAC Settings[2]	0.396	0.179	−0.585	−0.540	0.309	0.253	—	—	—	—	—
HHA–LTCH–SNF/IRF[3]	0.407	0.179	−0.653	0.238	0.313	0.269	0.267	—	—	—	—
HHA–Inpatient Diagnostic Groups[4]	0.537	0.179	−0.618	−0.394	0.511	0.442	—	0.425	0.555	0.441	0.222
Setting-Specific[5]	0.436	0.179	0.303	0.238	0.307	0.308	—	—	—	—	—

1 The All-PAC Settings models are composed of two components: (1) a component predicting whether therapy services are used and (2) a component predicting the amount of services used if positive.

2 The HHA–Inpatient PAC Settings models are composed of three components: (1) an HHA-only component predicting whether therapy services are used; (2) an HHA-only component predicting the amount of services used if positive; and (3) an inpatient PAC-only component predicting the amount of services used.

3 The HHA–LTCH–SNF/IRF models are composed of four components: (1) an HHA-only component predicting whether therapy services are used, (2) an HHA-only component predicting the amount of services used if positive, (3) an LTCH-only component predicting the amount of services used, and (4) a combined SNF and IRF component predicting the amount of services used.

4 The HHA–Inpatient Diagnostic Groups models are composed of six components: (1) an HHA-only component predicting whether therapy services are used; (2) an HHA-only component predicting the amount of services used if positive; (3-6) separate inpatient PAC-only components predicting the amount of services used for neurologic patients, orthopedic patients, respiratory patients, and patients with other medical/surgical primary diagnoses.

5 The Setting-Specific models are composed of five components: (1) an HHA-only component predicting whether therapy services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) separate IRF-, LTCH-, and SNF-specific components predicting the amount of services used.

NOTE: All models include 6,705 patients in the analytic sample. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; Med/Surg = Medical/surgical diagnoses, not otherwise categorized; MSE = mean-squared error; Neuro = neurological; Ortho = orthopedic; PAC = post-acute care; Resp = Respiratory; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-17
Ratio of predicted-to-actual routine resource intensity index for weighted inpatient PAC stay/HHA episode routine resource intensity index models, by setting

Model	HHA	IRF	LTCH	SNF
All-PAC Settings[1]	2.344	0.845	0.806	0.799
HHA–Inpatient PAC Settings[2]	1.000	1.059	0.870	1.020
HHA–LTCH–SNF/IRF[3]	1.000	0.963	1.000	1.003
HHA–Inpatient Diagnostic Groups[4]	1.000	1.033	0.886	1.019
Setting-Specific[5]	1.000	1.000	1.000	1.000

[1] The All-PAC Settings models are composed of two components: (1) a component predicting whether routine services are used and (2) a component predicting the amount of services used if positive.

[2] The HHA–Inpatient PAC Settings models are composed of three components: (1) an HHA-only component predicting whether routine services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) an inpatient PAC-only component predicting the amount of services used.

[3] The HHA–LTCH–SNF/IRF models are composed of four components: (1) an HHA-only component predicting whether routine services are used, (2) an HHA-only component predicting the amount of services used if positive, (3) an LTCH-only component predicting the amount of services used; and (4) a combined SNF and IRF component predicting the amount of services used.

[4] The HHA–Inpatient Diagnostic Groups models are composed of six components: (1) an HHA-only component predicting whether routine services are used; (2) an HHA-only component predicting the amount of services used if positive; (3-6) separate inpatient PAC-only components predicting the amount of services used for neurologic patients, orthopedic patients, respiratory patients, and patients with other medical/surgical primary diagnoses.

[5] The Setting-Specific models are composed of five components: (1) an HHA-only component predicting whether routine services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) separate IRF-, LTCH-, and SNF-specific components predicting the amount of services used.

NOTE: All models include 6,705 patients in the analytic sample. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MSE = mean-squared error; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Table 11-18
Ratio of predicted-to-actual therapy resource intensity index for weighted inpatient PAC stay/HHA episode therapy resource intensity index models, by setting

Model	HHA	IRF	LTCH	SNF
All-PAC Settings[1]	1.345	0.917	0.868	0.869
HHA–Inpatient PAC Settings[2]	1.000	1.000	0.761	1.011
HHA–LTCH–SNF/IRF[3]	1.000	0.989	1.000	1.001
HHA–Inpatient Diagnostic Groups[4]	1.000	1.032	0.896	1.002
Setting-Specific[5]	1.000	1.000	1.000	1.000

[1] The All-PAC Settings models are composed of two components: (1) a component predicting whether therapy services are used and (2) a component predicting the amount of services used if positive.

[2] The HHA–Inpatient PAC Settings models are composed of three components: (1) an HHA-only component predicting whether therapy services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) an inpatient PAC-only component predicting the amount of services used.

[3] The HHA–LTCH–SNF/IRF models are composed of four components: (1) an HHA-only component predicting whether therapy services are used, (2) an HHA-only component predicting the amount of services used if positive, (3) an LTCH-only component predicting the amount of services used; and (4) a combined SNF and IRF component predicting the amount of services used.

[4] The HHA–Inpatient Diagnostic Groups models are composed of six components: (1) an HHA-only component predicting whether therapy services are used; (2) an HHA-only component predicting the amount of services used if positive; (3-6) separate inpatient PAC-only components predicting the amount of services used for neurologic patients, orthopedic patients, respiratory patients, and patients with other medical/surgical primary diagnoses.

[5] The Setting-Specific models are composed of five components: (1) an HHA-only component predicting whether therapy services are used, (2) an HHA-only component predicting the amount of services used if positive, and (3) separate IRF-, LTCH-, and SNF-specific components predicting the amount of services used.

NOTE: All models include 6,705 patients in the analytic sample. CRU = cost and resource utilization; HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MSE = mean-squared error; PAC = post-acute care; RII = resource intensity index; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

SECTION 12
CONCLUSIONS AND REVIEW OF FINDINGS

The Post-Acute Care Payment Reform Demonstration (PAC-PRD) was successful in its efforts to develop and apply a consensus-based, uniform approach for measuring medical, functional, and cognitive complexity in Medicare populations and to set national standards for documenting key clinical factors that can be used to monitor the Medicare program. Almost 200 providers, including acute hospitals, long-term care hospitals (LTCHs), inpatient rehabilitation facilities (IRFs), skilled nursing facilities (SNFs), and home health agencies (HHAs) participated nationally to collect data over the 3 years of the demonstration. Feedback from the clinical communities and associations was positive and helpful for refining the items during the development period. The result is an extensive database describing the complexity and costliness of post-acute populations, including both the critically, chronically ill and the healthier Medicare beneficiary who may be admitted to a hospital or use one of the four post-acute care (PAC) sites of care.

The PAC-PRD provided information on beneficiaries' medical, functional, and cognitive complexity and the resources used to treat them in each setting. This type of information was needed to better understand the current PAC delivery system, how each type of provider functions within that system, and how provider roles differ according to the availability of alternative options in a local market area. The information also will help in consideration of the implications for improving the consistency of the four Medicare PAC payment policies.

This final section of the Final Report briefly reviews the key findings associated with the analytic information presented in Sections 6 to 11.

12.1 Key Findings for Analysis of Factors Associated With First Sites of PAC

Section 6 presented a number of models examining factors associated with the use of PAC after a hospitalization and is important for understanding the similarities and differences in the types of populations using PAC providers after hospital discharge. The analysis focused on the first discharge destination after a hospital stay and thus excluded home health cases that were not PAC and cases that were secondary PAC admissions. The results presented in this section provided an opportunity to compare PAC users on the constellation of medical, functional, and cognitive status factors associated with patients using each type of setting. These analyses do not attempt to answer the question of where patients should go, but instead examine the existing patterns of care given the regulations and incentives currently in the marketplace.

The analysis was the first large-scale analysis using standardized items that could allow comparisons of the populations being admitted to each setting. By using the same approaches to specify precipitating medical conditions and existing comorbidities, and the same measures of pressure ulcers, history of falls, functional status and impairments, and cognitive status, one could finally consider whether the same types of patients are treated in more than one setting and start to discuss differences in clinical complexity that may exist within and across PAC settings.

These results provided important information on the types of cases being treated in each PAC setting or going home without PAC. On average, after controlling for receiving services in a high or low PAC area, the types of patients treated in each of the four settings had overlapping characteristics, although the odds of using each type of service may have differed by individual characteristics.

While the complexity of patients using each PAC setting tended to differ across settings, the results suggest that the populations using PAC also appeared to overlap in the types of conditions and impairments being treated in each level of care. Notably, the results showed that medical cases were more likely to be discharged to home health, SNF, and LTCH, while post-surgical cases typically needing physical rehabilitation tended to be discharged to IRFs, SNFs, and HHAs. Medical factors, such as primary diagnosis in the acute hospital, were important but not sufficient for predicting subsequent PAC use. Comorbidities played an important role in identifying the difference in the potential complexity of cases treated in each setting. For example, the odds were greatest for the LTCH setting when more medical comorbidities were present. However, when the comorbidities were the type that required therapy services, such as orthopedic/musculoskeletal conditions and neurological conditions, patients had higher odds of IRF or SNF use. Similarly, cases with higher medical resource needs, such as being discharged on a ventilator, requiring hemodialysis, or being discharged with no food intake by mouth (NPO) were all associated with greater odds of being discharged to an LTCH. Interestingly, after controlling for the other factors in the model, LTCH cases had no greater odds of their patients having had an intensive care unit stay longer than 7 days.

Functional status was also an important factor in explaining site of care. While IRF patients frequently have falls problems, the models suggest that after controlling for the other patient characteristics, patients with a history of falls have no higher likelihood of being discharged to an IRF. However, falls history is significantly associated with higher odds of being discharged to an SNF, all other patient characteristics being equal.

Similarly, the relationship between the self-care and mobility score at time of transfer and discharge destination was curvilinear in nature. In other words, while the SNF and IRF have significantly higher odds of taking patients with higher self-care scales, the square term is negative suggesting a lower likelihood of patients being discharged to these settings once the self-care score is too high. Similar results are shown with mobility scores, although the two settings with the higher odds of accepting patients with higher scores at admission are HHAs and IRFs, but again, these scales reach a point where the patient is significantly less likely to be admitted to these settings as the mobility scale increases. And as with the medical characteristics, these factors are significant in more than one setting, underscoring the overlap in patients admitted to the different sites of care.

Cognitive impairments were also significantly associated with PAC use. Depression was associated with higher odds of using all four PAC settings, although HHAs to a lesser degree.

Two of the models presented, the SNF/IRF and the SNF/HHA, allowed better understanding of the characteristics differentiating treatment between these settings. It was notable that neurological patients had significantly higher odds of being discharged to an IRF than an SNF when the sample was restricted to the two groups, but many of the other diagnosis and comorbid factors remained similar to the multinomial model. However, this is a relative finding and not suggestive that these cases are not treated in SNFs.

The role of HHAs in treating some of the more chronic populations was also notable. After controlling for primary diagnosis and comorbidities, the cases with severe respiratory status impairments and those with limited endurance (could endure with support or rest) had higher odds of being discharged to HHAs than SNFs. However, cases with a history of falls had higher odds of being discharged to an SNF than an HHA, perhaps related to the concern over patient safety when discharging them to the home environment.

Together, these results present a picture of the constellation of factors associated with patients in these settings. Medicare patients are complex, unlike younger, non-disabled populations, Medicare beneficiaries tend to have multiple factors affecting their general health status. These analyses were useful for empirically identifying some of the overlapping characteristics and beginning to consider the ways in which PAC populations or subpopulations may differ. The findings showed that patients with these types of medical, functional, and cognitive factors generally had a higher probability of using PAC than being discharged home without further services. While the magnitude may vary by setting, these findings underscore that PAC settings do treat overlapping populations. Understanding whether treatment outcomes and resource intensity associated with treating these cases differs across the PAC settings is needed to consider the appropriate approach for payment reform.

12.2 Key Findings and Next Steps for Functional Outcomes and Rehospitalization Models

The functional outcomes and rehospitalization analyses presented in Sections 7 and 8 were also important for understanding whether different types of PAC settings achieved different results after controlling for patient characteristics. It should be noted that these analyses focus on outcomes per stay, not differences in daily effects. The SNF stay was on average twice as long as the IRF admission, whereas the HHA effects were related to a complete HHA admission, regardless of the number of 60-day episodes. Three outcomes were examined: (1) change in self-care functioning from admission to discharge, (2) change in mobility functioning from admission to discharge, and (3) readmission to the hospital within 30 days.

12.2.1 Changes in Self-Care Function

Self-Care at Admission—Across the whole sample and the condition-specific samples, HHAs admitted patients with the highest mean self-care measures (overall: 59.9, musculoskeletal: 58.5, nervous system: 55.5), and LTCH patients had the lowest (overall: 33.9, musculoskeletal: 41.8, nervous system: 33.1), suggesting that patients admitted to HHAs were the least impaired in self-care and that LTCH admissions were the most impaired. Cases admitted to IRFs were slightly more impaired than those admitted to SNFs (43.6 compared with 45.4 at admission, respectively). This difference was true in both the musculoskeletal and nervous system subpopulations.

Changes in Self-Care Function—Overall, the mean change in self-care function was 12.4, with a standard deviation of 13.8 units. IRF patients had the greatest self-care change overall (15.5 units) and within each of the subpopulations (17.4 units in the musculoskeletal and 13.8 units in the nervous system patients). SNF patients achieved the second highest unadjusted change scores in the overall patients (12.4 units improvement) and in the musculoskeletal patients (15.5 units improvement). In the nervous system populations, LTCHs and SNFs achieved very similar results (10.4 and 10.1 units improvement, respectively). HHAs tended to achieve slightly smaller improvements in self-care, overall and in the nervous system groups specifically.

After adjusting for patient characteristics, we found that IRFs and HHAs had significantly greater improvement in self-care outcomes than SNFs, with some variation in results associated with different diagnosis groups. Across all conditions, IRFs achieved a 30 percent better self-care status at discharge relative to SNF achievement, after controlling for patient case-mix characteristics. HHAs had a 32 percent better self-care outcome than SNFs, after controlling for patient case-mix differences. These differences may be related to unmeasured factors such as patient levels of engagement or differences in family involvement in these settings relative to an SNF.

The multivariate adjusted effects also differed by diagnosis. For musculoskeletal cases, HHAs had a 35 percent better gain in self-care outcomes than SNFs, but IRFs and LTCHs had no significantly different self-care outcomes than SNFs. For patients with nervous system disorders, including stroke cases, IRFs achieved 32 percent better functional improvement in self-care than SNF patients at discharge, and HHA patients achieved 22 percent greater improvement.

It is important to note that the multivariate models focused on adjusting for clinical characteristics at admission and did not attempt to address factors such as patient engagement that may differ systematically between settings.

12.2.2 Changes in Mobility Function

Mobility Function at Admission—Across the whole sample and the condition-specific samples, HHAs had the highest mean admission mobility measures (overall: 59.9, musculoskeletal: 57.3, nervous system: 54.0), and LTCHs had the lowest (overall: 33.5, musculoskeletal: 37.0, nervous system: 33.7), suggesting that patients who were least impaired in mobility were more typically admitted to HHAs and that, on average, LTCH patients were the most impaired in their mobility on admission.

Changes in Mobility—The mean unadjusted change in mobility from admission to discharge for the overall sample was 14.6, with a standard deviation of 14.6 units. IRFs and SNFs had the greatest change in unadjusted mobility scores over all patients (16.7 units and 16.6 units, respectively) and in musculoskeletal patients (19.4 and 20.7 units, respectively). Among the more complex nervous system disorder patients, those treated in IRFs achieved 14.8 units of improvement, whereas those treated in SNFs achieved 12.6 units and LTCH patients improved 11.2 units, followed by HHA patients with a 10.4 unit change. However, these results are not adjusted for variation in patient characteristics.

Differences in mobility at discharge were also examined using multivariate models that controlled for patient characteristics. In these models, provider setting did not have a significant effect, suggesting that, after controlling for patient characteristics, each setting was achieving similar levels of mobility improvement by discharge. This finding was also true for each of the condition-specific models. These multivariate results are useful for considering differences in impact when similar types of patients are admitted to each setting, but one must also recognize the differences in the types of medical complexity associated with admissions to each setting.

12.2.3 Readmission within 30 Days of Acute Hospital Discharge

The third outcome we examined was hospital readmissions. This was a key outcome for considering the impact of medical treatments on returning the patient to a better health status. Among the four populations, LTCHs appear to have lower probability of readmissions within 30 days of discharge from the initial acute hospital relative to SNFs, although related work suggests this effect changes during the subsequent 30 days after discharge. Both the capacity of LTCHs to deal with higher severity patients and the greater routine intensity provided by an LTCH may be associated with this finding. No significant differences were found between IRFs or HHAs and SNFs in the probability of 30-day hospital readmissions.

Further work is needed in this area to better understand and validate the preliminary findings reported here and to examine additional measures of outcomes. Analysis that further links outcomes to payment and other incentive structures will be examined in the final project report for this demonstration.

12.3 Key Findings for Resource Intensity Analyses

An important goal of this demonstration was to measure the costs and outcomes associated with treatment in each of the four PAC settings and to ascertain the determinants of those costs. The results of this analysis are presented in Sections 9 to 11. The goal was to measure the costs (both routine and therapy intensity) in each setting and to determine the extent to which treatment intensity differs by setting and, when treating similar types of patients, whether treatment intensity differs by setting of care. We analyzed the data, which reflect current utilization practices, using several sets of resource intensity models. The models incorporated explanatory variables such as demographics, data elements from claims, and the items in the Continuity Assessment Record and Evaluation (CARE) tool. A major question was to determine whether a common set of patient characteristics could be used to predict resource utilization in all settings.

12.3.1 Unadjusted Resource Intensity Findings

We found that the unadjusted, average routine resource intensity differed by setting in expected ways: LTCHs had the highest unadjusted routine resource intensity per stay, with about 3 times the staff resources per patient than in the IRF or SNF settings (161.4 RN-equivalent hours, compared with 58.6 and 50.9 RN-equivalent hours, respectively). HHAs had the lowest average unadjusted nursing resource intensity per patient, with a mean routine resource intensity index (RII) of 5.3 RN-equivalent hours per 60-day home health episode). The lower numbers in HHAs reflect the nature of services in this setting where care is provided through visits rather than on a 24-hour basis as in an inpatient PAC setting.

Unadjusted average therapy intensity per inpatient PAC stay also differed by setting. The stay-level unadjusted therapy intensity was greatest in IRFs, with a mean of 47.6 licensed therapist-equivalent hours per person per stay followed by a slightly lower stay-total in SNFs, with a mean of 43.9 therapist-equivalent hours per stay, and followed by LTCHs with 33.1 therapist-equivalent hours per patient stay.

The frequency of therapy care within a stay also varies across settings. On average, IRF patients received therapy 5.2 days per week (or 74 percent of days), while SNF patients received therapy care 4.3 days per week (or 62 percent of days). Therapy was provided to LTCH patients 3.8 days per week (or 55 percent of days) on average. Roughly 52 percent of HHA days included some therapy.

12.3.2 Multivariate Resource Intensity Findings

A major focus of the analysis in this section is to evaluate the degree to which it makes sense to move toward increased consistency in payment models among the four PAC settings. There are many ways CMS can consider moving toward greater consistency in recognizing patient-level variable costs in payment, including but not limited to the following:

- Consistency in whether different sources of patient costs are modeled together or independently (e.g., the use of separate or combined models for nursing, therapy, drugs, and other nontherapy ancillaries)
- Consistency in how different aspects of patient acuity are measured across settings
- Consistency in the impact of a particular acuity score on predicted resource needs
- Consistency in the base rate associated with the model
- Consistency in whether the same payment unit is used, and if so, whether it should be a day, admission, or another unit of payment

Several types of multivariate models were tested to evaluate this issue. The first model examined whether one model could be used across all four PAC settings. The results suggested that HHAs differed from the three inpatient PAC settings in the factors predicting resource intensity. A second set of resource intensity models separated the three inpatient PAC settings from HHAs to test whether this improved the power of the models, which it did. A third model tested combining only the IRF and SNF cases to determine whether this further improved the model fit. Separate models were run for each of the four settings (HHA, SNF, IRF, and LTCH) to identify the best fit possible. Another model combining all the inpatient settings was tested with the patients stratified into four subgroups classified by clinical type: neurological, orthopedic, respiratory and other medical/surgical. The same set of explanatory variables, defined in a consistent manner across settings, was used in all models.

A major focus in evaluating the models was the power to predict the resource use in each of the settings. Models incorporating data from multiple settings were created and tested by computing an R-squared measure of explanatory power for patients in each facility type separately. This kind of test allows one to see the degree to which a combined model loses the power to predict for each individual type of setting. This is of interest because the providers are paid with very different systems now and unifying the payment systems could produce different payment amounts when the payment determinants are changed.

Using different econometric approaches we consistently found that combining the HHA population with the inpatient PAC settings produced poor results for both the HHAs and the inpatient PAC settings. With the HHA setting treated separately, we concentrated on model formulations for the inpatient PAC settings.

The R-squareds for routine resource intensity are noted in **Table 12-1**. In most cases the best explanatory power is produced by the setting-specific model. In the case of LTCHs, however, the diagnosis-stratified model is better. However, it should be noted that it may not necessarily be desirable to produce the highest R-squared at the setting level, depending on the policy objectives. For example, the observed patterns of resource intensity use are not only driven by patient characteristics, but by the incentives of the payment systems and regulations governing each setting. The best fit could be "overfitting" idiosyncrasies. The table shows that the All-PAC settings model including HHAs does not work well.

Table 12-1
Mean-squared error (MSE)-based R-squareds for inpatient stay/HHA episode-level routine resource intensity index models (extract from Table 11-8)

Model	Global	HHA	IRF	LTCH	SNF
All-PAC Settings	0.683	−5.021	0.185	0.565	0.033
HHA–Inpatient PAC Settings	0.745	0.141	0.249	0.619	0.093
HHA–LTCH–SNF/IRF	0.769	0.141	0.381	0.645	0.223
HHA–Inpatient Diagnostic Groups	0.788	0.141	0.316	0.699	0.180
Setting-Specific	0.778	0.141	0.424	0.645	0.377

NOTE: A computed MSE-based R-squared may be negative if the explanatory power is very poor. HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MSE = mean-squared error; PAC = post-acute care; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

Even when separated into its own model, the HHA explanatory power is worse than the inpatient PAC explanatory power. Compared to the setting-specific models, the combined models that best fit current practice patterns are the model with SNF and IRF combined and the model with all inpatient PACs combined but with splits on diagnostic groups. The former is almost a full setting-specific model. The latter is conceptually different in that the splits are clinically based. This does not eliminate the fact that the data reflect existing patterns of care, but it does not explicitly model on the settings.

The R-squareds for therapy resource use are noted in **Table 12-2.**

Table 12-2
Mean-squared error (MSE)-based R-squareds for inpatient stay/HHA episode-level therapy resource intensity index models (extract from Table 11-9)

Model	Global	HHA	IRF	LTCH	SNF
All-PAC Settings	0.281	−0.391	0.158	0.043	0.040
HHA–Inpatient PAC Settings	0.356	0.179	0.186	0.028	0.129
HHA–LTCH–SNF/IRF	0.387	0.179	0.225	0.237	0.132
HHA–Inpatient Diagnostic Groups	0.460	0.179	0.301	0.130	0.329
Setting-Specific	0.463	0.179	0.302	0.237	0.306

NOTE: A computed MSE-based R-squared may be negative if the explanatory power is very poor. HHA = home health agency; IRF = inpatient rehabilitation facility; LTCH = long-term care hospital; MSE = mean-squared error; PAC = post-acute care; SNF = skilled nursing facility.

SOURCE: RTI International analyses of CARE tool and CRU data for the CARE+CRU sample: the set of CARE patients with matched claims and CRU data collection forms.

One interesting aspect of the therapy models at the setting-specific level is that, compared to the routine resource use models, the explanatory power is higher for HHAs and lower within the inpatient PAC settings. The SNF R-squared is slightly lower, the IRF a bit more so, and the LTCH R-squared is considerably lower. As with routine services, the All-PAC setting model which integrates the HHA population with the inpatient PAC settings into one model that enforces complete consistency works poorly. The model combining SNF and IRF and the all-inpatient PAC diagnostic group model are the best combined models for modeling the therapy resource intensity index.

For both routine and therapy resource use, the models spanning settings that work best differ in the nature of the division of the population used to build the models. One splits directly on setting, combining only the IRFs and SNFs. The other splits only on patient characteristics after separating HHAs and works about as well when tested at the setting level. One aspect of all the models that is different from the past is the common set of explanatory variables used. This includes the use of items from a common patient assessment instrument, CARE, administered at the same point in the patient stay. Currently the IRFs, SNFs, and HHAs each use different instruments and the LTCH system uses none. Even barring any additional movement toward consistency in the payment systems, the use of consistent measures assessed at equivalent time points represents a marked improvement. Additional aspects of all the models examined is a consistent approach to modeling the stay-level resource use, and a separate model for routine and therapy within all the settings examined.

12.4 CARE Tool After the Demonstration

The Continuity Assessment Record and Evaluation (CARE) tool was designed as a set of items that could uniformly measure concepts already largely included in the different PAC prospective payment systems (PPSs). The implementation of CARE within the demonstration was successful. All five settings were able to use the CARE items to collect information in a consistent, reliable, and comprehensive manner for their Medicare populations. Participant feedback on CARE was generally positive, with support from each clinical community for CMS' effort to use nationally accepted standards, as in the case of the pressure ulcer development, or to improve on weaknesses in the current measures, as in the functional status items. The CARE function items addressed some of the ceiling and floor effects associated with the current assessment instruments and provided greater specificity for measuring change than the current Minimum Data Set (MDS) and Outcome and Assessment Information Set (OASIS) function items.

Reliability testing for the CARE items showed that these items met the same standards of reliability as the current CMS-mandated patient assessment items. Overall, the interrater reliability results showed very good agreement on most items, suggesting that these items could be used to measure a patient's progress in a standardized way across an episode of care.

The development and testing of the CARE tool was undertaken with the assumption that the CARE tool items can and should have a life beyond the demonstration. The demonstration has shown that the standardization of assessment items across settings is both possible and desirable for a variety of reasons, including more comparable measurement of function and other outcomes, more comparable risk adjustment, and better payment modeling. The demonstration also showed that the collection of patient-specific information in hospital settings such as general hospitals and LTCHs is advisable to better specify differences in the medical, functional, and cognitive complexity of patients treated in these settings.

12.5 Next Steps

These results have shown what can be done with standardized assessment data. The CARE data are being used in ongoing CMS efforts to drill down further in looking at some of the similarities and differences among the Medicare population needing physical rehabilitation medicine and those at the other end of the spectrum who may be chronically, critically ill. This work has provided a start to understanding whether similar populations are treated in more than one PAC setting. The results clearly indicate that overlap and substitution exist, although they also highlight that differences in complexity among settings may also be found. Overall, the results highlight the varying characteristics of the Medicare PAC populations and the importance of being able to control for medical, functional, and cognitive status in considering payment reform. More work is needed to develop payment models that will minimize the uncertainty in changing payment systems but improve the consistency of the incentives associated with use across an episode of care.

The CARE items are also being used to consider quality measures. Having standardized measures of case-mix complexity will allow the Medicare program to develop setting-neutral measures that will monitor similar patient outcomes, regardless of site of care. Standardized items are already being incorporated into the LTCH quality reporting program and are being considered for other measures as well.

Translating the findings presented in this project into actual payment models will require additional work. For example, in future payment projects, two cost components will need further consideration to refine the Medicare payment models. First, further analysis of the patient-specific cost of nontherapy ancillary use is needed to understand how these costs vary by patient complexity. These considerations will be important for determining whether the ancillary costs should be an independent cost component or are highly correlated with any of the medical or functional factors. Current payment approaches for these services that vary by setting will also need to be considered.

Another outstanding cost component is the fixed cost analysis. This demonstration focused on the variable costs associated with patient characteristics. Before designing a unified payment model, the different fixed costs associated with each level of care (e.g., a hospital compared to a nursing facility compared to an HHA) will need to be taken into account. These standard costs can be tied to organizational features, such as size, volume, capital, and other factors that do not vary by patient characteristics and should be considered separate from the variable patient costs.

Additionally, the desirability and feasibility of a composite cost measure that combines the routine, therapy, nontherapy ancillaries, and fixed costs needs to be considered. This report presented analyses of the first two payment components: routine/nursing services and therapy services. Additional payment components, for ancillary service use and for "fixed" setting-specific indirect operating costs, would need to be incorporated to create a complete PPS for the PAC settings. And, ultimately, additional analyses that attempt to link selected outcomes to payment and other incentive structures also will be important.

The results of the analyses in this report demonstrate the importance of including consistent measures of patient medical, functional, and cognitive status in the payment model and of understanding resource intensity variations when considering future PAC PPSs that will optimize patient care while making prudent use of Medicare program/Trust fund dollars.

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